MODEL 7004A
DIGITAL MULTIMETER

SERIAL NO.

Ⓑ

SYSTRON DONNER

Concord Instrument Division

INSTRUCTION MANUAL

MODEL 7004A
DIGITAL MULTIMETER

SERIAL NO.

(B)

© Copyright 1973 Systron-Donner Corporation

SYSTRON DONNER CORPORATION

TEN SYSTRON DRIVE, CONCORD, CALIFORNIA 94518 U.S.A.
Tel: (415) 682-6161, TWX: 910-481-9479, Cable: SYSTRONDONNER

SYSTRON DONNER
CORPORATION

WARRANTY

Systron-Donner instruments are warranted during a period of one year from date of shipment to original purchaser to be free from defects in material and workmanship. This warranty does not apply to vacuum tubes, except as these are warranted by tube manufacturers. The liability of Seller under this warranty is limited to replacing or repairing any instrument or component thereof which is returned by Buyer, at his expense, during such period and which has not been subjected to misuse, neglect, improper installation, repair, alteration, or accident. Seller shall have the right to final determination as to the existence and cause of a defect. In no event shall Seller be liable for collateral or consequential damages. This warranty is in lieu of any other warranty, expressed, implied, or statutory; and no agreement extending or modifying it will be binding upon Seller unless in writing and signed by a duly authorized officer.

RECEIVING INSPECTION

Every Systron-Donner instrument is carefully inspected and is in perfect working order at the time of shipment. Each instrument should be checked as soon as received. If the unit is damaged in any way, or fails to operate, a claim should immediately be filed with the transportation company.

REPAIRS

Whenever a Systron-Donner instrument requires service, the nearest Systron-Donner representative should be contacted; all representatives will provide immediate service or arrange factory returns when necessary.

Please specify both model and serial number in all correspondence concerning Systron-Donner instruments. Address all inquiries on operation or applications to your nearest sales representative; or, Sales Manager, Concord Instrument Division, Systron-Donner Corporation, 10 Systron Drive, Concord, California 94518.

TABLE OF CONTENTS

		Page
CHAPTER 1 - GENERAL INFORMATION		
1.1	Introduction	1-1
1.2	Specifications	1-1
1.3	Optional Features	1-5
CHAPTER 2 - INSTALLATION		
2.1	Introduction	2-1
2.2	Receiving Inspection	2-1
2.3	Reshipment	2-1
2.4	Power Requirements	2-2
2.5	Acceptance Test Procedure	2-2
CHAPTER 3 - OPERATION		
3.1	Introduction	3-1
3.2	Controls, Connectors and Indicators	3-1
3.2.1	Front Panel	3-1
3.2.2	Rear Panel Functions	3-3
3.3	Operating Procedures	3-5
3.3.1	Sample Rate and Hold Control	3-6
3.3.2	Guard Terminal	3-6
3.3.3	Overload Protection	3-6
3.3.4	mV Zero Adjustment	3-7
CHAPTER 4 - MAINTENANCE		
4.1	Introduction	4-1
4.2	Factory Service	4-1
4.3	Routine Maintenance	4-1
4.4	Printed-Circuit Board Repair	4-2
4.5	Test Equipment	4-3
4.6	Calibration Procedures	4-3
4.6.1	Power Supply Voltages	4-4
4.6.2	Calibration	4-4
CHAPTER 5 - CIRCUIT DESCRIPTIONS, DRAWINGS, AND PARTS LISTS		
5.1	Introduction	5-1
5.2	Dual-Slope Integration	5-1
5.3	Circuit Descriptions	5-2
5.4	Parts List Column Description	5-3
5.5	Manufacturer's Index	5-3
037190-7-1	Model 7004A Block Diagram	5-9
037190-4-1	Final Assembly	5-10
037197-4-1	Test Assembly	5-11
037198-4-1	Front Panel Assembly	5-12
037747	Rear Panel Assembly	5-13
037470-6-1	Specification Transformer Assembly	5-14

TABLE OF CONTENTS (Cont'd)

		Page
CHAPTER 5 - CIRCUIT DESCRIPTIONS, DRAWINGS, AND PARTS LISTS (Cont'd)		
037190	Final Assembly Parts List	5-15
037197-4-1	Test Assembly Parts List	5-17
037198-4-1	Front Panel Assembly Parts List . . .	5-19
037747	Rear Panel Assembly Parts List	5-20
037215-7-1	A1, Count Chain and Readout Circuit Description	A1-1
	Assembly	A1-3
	Schematic	A1-4
	Parts List	A1-5
037206-4-1	Tube Retainer Assembly	A1-15
	Parts List	A1-16
037235-4-1	Minus Bracket Assembly	A1-17
	Parts List	A1-18
037217-7-1	A2, Switch Board Circuit Description .	A2-1
	Assembly	A2-5
	Schematic (Sheet 1 of 2)	A2-6
	Schematic (Sheet 2 of 2)	A2-7
037217-3-1	S1-S10, Switch Wiring Subassembly . .	A2-8
	Parts List	A2-9
CHAPTER 6 - OPTIONS AND ACCESSORIES		
6.1	Introduction	6-1
037218-7-1	Option 05, BCD Output Circuit Description	OPT 05-1
	Assembly	OPT 05-3
	Schematic	OPT 05-4
	Parts List	OPT 05-5
037219-4-1	Option 09, Battery Pack Circuit Description	OPT 09-1
	Assembly	OPT 09-3
	Parts List	OPT 09-4
037469-7-1	Option 09, A3, Battery Pack Assembly .	OPT 09-5
	Schematic	OPT 09-6
	Parts List	OPT 09-7
037232-4-1	Accessory, Input Test Leads Circuit Description	ACC-1
	Assembly	ACC-2
	Parts List	ACC-3
045410	Accessory, Single Rack Mount Kit Circuit Description	ACC-4
	Assembly	ACC-5
	Parts List	ACC-6
037492-3	Accessory, Dual Rack Mount Kit Circuit Description	ACC-7
	Assembly	ACC-8
	Parts List	ACC-9

TABLE OF CONTENTS (Cont'd)

		Page
CHAPTER 6 - OPTIONS AND ACCESSORIES (Cont'd)		
037229-4-1	Accessory, Front Cover Circuit Description	ACC-10
	Assembly	ACC-11
	Parts List	ACC-12
CHAPTER 7 - SPECIAL MODIFICATIONS		
7.1	Introduction	7-1
CHAPTER 8 - SUPPLEMENTAL INFORMATION		
8.1	Introduction	8-1

LIST OF FIGURES

Figure 3.1	Front Panel, Model 7004A	3-2
3.2	Rear Panel, Model 7004A	3-2
3.3	Mounting the A1 Readout Board for Access to A1 Readout Board and Bottom of A2 Switch Board	3-8
4.1	Location, Calibration Controls	4-5
4.2	Typical Temp. Comp. Graph	4-7

LIST OF TABLES

Table 2.1	Acceptance Test Procedure	2-3
3.1	Front Panel Functions	3-1
3.2	Rear Panel Functions	3-4
3.3	Operating Procedures	3-6
4.1	Test Equipment for Model 7004A	4-3
4.2	Power Supply Voltages	4-4
4.3	Resistance Calibration	4-8
4.4	DC Voltage Calibration	4-9
4.5	DC Current Calibration	4-10
4.6	AC Current Calibration	4-11
5.1	Drawing Index Information	5-2
5.2	Code-to-Name Cross-Reference	5-3
6.1	Option Drawing Index	6-1

Digitized by the Internet Archive
in 2025

https://archive.org/details/manualsplus_08525

CHAPTER 1
GENERAL INFORMATION

1.1 INTRODUCTION

The SD Model 7004A Digital Multimeter is a full four-digit precision instrument. It offers the five selectable functions of dc voltage, dc current, ac voltage, ac current and resistance. The instrument utilizes an advanced Dual-Slope Integration design with an extremely low-noise input amplifier and a fully guarded, isolated input circuit. These features combine to provide high accuracy and stability, plus exceptional immunity to the effects of both common mode and normal mode noise.

All function and range selection is made from front-panel pushbutton controls. The readout features a nonblinking display of four full digits plus overrange, auto-positioned decimal point, and an indicator for off-scale readings. Polarity indication for dc voltage and current is automatic with a minus indicator display.

Model 7004A is light-weight and completely portable. It consumes less than 8 watts while operating at line frequencies from 48 to 440 Hz and at voltages of 115/230 V or 100/200 V. The Multimeter may be fitted with an optional built-in battery pack with no increase in size. Optional DTL/TTL compatible digital outputs can also be included for remote printout, digital limit comparison, or other automatic data system requirements.

1.2 SPECIFICATIONS

DC VOLTS

Range:	±.10000 V, ±1.0000 V, ±10.000 V, ±100.00 V, ±1000.0 V.
Resolution:	±10 μV to ±0.1 V in decade steps depending on range.
Overrange:	30% on all ranges except on 1000 V range. Maximum readings are ±.13000 V, ±1.3000 V, ±13.000 V, ±130.00 V and ±1000.0 V at full accuracy.
Polarity Selection:	Automatic with minus indicator.
Input Impedance:	>1000 MΩ on 0.1 V, 1 V, and 10 V ranges. 10 MΩ on 100 V and 1000 V ranges.

DC VOLTS (Cont'd)

Accuracy:	All ranges except 0.1 V range (25±5°C); ±0.01% rdg. ±0.01% f.s. for 1 month. ±0.02% rdg. ±0.01% f.s. for 3 months. 0.1 V range (25±1°C); ±0.02% rdg. ±0.02% f.s. for 1 month.
Temperature Stability (0°C to 50°C):	All ranges except 0.1 V range; ±0.001% rdg. ±0.001% f.s./°C. 0.1 V range; ±0.005% rdg. ±0.01% f.s./°C.
Full-Scale Step Response:	1 second to rated accuracy.
Normal Mode Noise Rejection:	>60 dB at 60 Hz.
Common Mode Noise Rejection:	>120 dB at dc; >100 dB from 49 Hz to 1 kHz with 1 kΩ source unbalance.
Maximum Input:	±1000 V on any range without damage.

DC CURRENT

Ranges:	±.10000 mA, ±1.0000 mA, ±10.000 mA, ±100.00 mA, ±1000.0 mA.
Resolution:	±10 nA to ±0.1 mA in decade steps depending on range.
Overrange:	30% on all ranges. Maximum readings are ±.13000 mA, ±1.3000 mA, ±13.000 mA, ±130.00 mA and ±1300.0 mA at full accuracy.
Polarity Selection:	Automatic with minus indicator.
Configuration:	Shunts, internal to instrument.
Accuracy:	All ranges except 0.1 mA range (25±5°C); ±0.1% rdg. ±0.01% f.s. for 3 months. 0.1 mA range (25±1°C); ±0.1% rdg. ±0.04% f.s. for 3 months.
Temperature Stability (0°C to 50°C):	±0.005% rdg. ±0.002% f.s./°C/ 1, 10, 100, 1000 mA ranges. ±0.005% rdg. ±0.01% f.s./°C. 0.1 mA range.
Full Scale Step Response:	1 second to rated accuracy.
Normal Mode Noise Rejection:	>60 dB at 60 Hz.

DC CURRENT (Cont'd)	
Common Mode Noise Rejection:	>120 dB at dc; >100 dB from 49 Hz to 1 kHz with 1 kΩ source unbalance.
Maximum Input:	100% above range selected without damage. Input fused at 1.5 A.

AC VOLTS	
Ranges (rms value):	.10000 V, 1.0000 V, 10.000 V, 100.00 V, 1000.0 V.
Resolution:	10 μV to 0.1 V in decade steps depending on range.
Overrange:	30% on all ranges except 1000 V range. Maximum readings are .13000 V, 1.3000 V, 13.000 V, 130.00 V, and 500.00 V.
Input Impedence:	1 MΩ shunted by 100 pF.
Accuracy (50 Hz to 20 kHz, except 1000 V range is 50 Hz to 10 kHz.)	All ranges except 0.1 V range (25±5°C); ±0.2% rdg. ±0.02% f.s. for 3 months. 0.1 V range (25±1°C); ±0.5% rdg. ±0.2% f.s. for 3 months.
Extended Frequency Response:	0.1, 1, 10, and 100 V ranges may be used to 100 kHz with ±2% typical accuracy.
Full-Scale Step Response:	3 seconds to rated accuracy.
Maximum Input:	500 V rms on 10 V, 100 V, and 1000 V ranges. 150 V rms on 0.1 V and 1 V ranges without damage.

AC CURRENT	
Ranges:	.10000 mA, 1.0000 mA, 10.000 mA, 100.00 mA, 1000.0 mA.
Resolution:	10 nA to 0.1 mA in decade steps depending on range.
Overrange:	30% on all ranges. Maximum readings are .13000 mA, 1.3000 mA, 13.000 mA 130.00 mA, and 1300.0 mA.
Configuration:	Shunts internal to instrument.

AC CURRENT (Cont'd)

Accuracy (50 Hz to 20 kHz):	All ranges except 0.1 mA range (25±5°C); ±0.3% rdg. ±0.02% f.s. for 3 months. 0.1 mA range (25±1°C); ±0.5% rdg. ±0.2% f.s. for 3 months.
Full-Scale Step Response:	3 seconds to rated accuracy.
Maximum Input:	100% above range selected without damage. Input fused at 1.5 A.

RESISTANCE

RANGE	CURRENT THRU RX	RX	RESOLUTION
1.0000 kΩ	5 mA	1 kΩ	0.1 Ω
10.000 kΩ	500 µA	10 kΩ	1 Ω
100.00 kΩ	50 µA	100 kΩ	10 Ω
1000.0 kΩ	5 µA	1000 kΩ	100 Ω
10.000 MΩ	0.5 µA	10 MΩ	1000 Ω

Overrange:	30% on all ranges. Maximum readings are 1.3000 kΩ, 13.000 kΩ, 130.00 kΩ, 1300.0 kΩ, and 13.000 MΩ at full accuracy.
Configuration:	Two-wire measurement system.
Accuracy:	All ranges (25±5°C); ±0.1% rdg. ±0.01% f.s.
Full-Scale Step Response:	Typical 1 second on all kΩ ranges; 3 seconds on 10 MΩ range.
Voltage Protection:	130 V rms without damage on all ranges except 1 kΩ. 35 V rms on 1 kΩ range.

GENERAL

Input Configuration:	Fully floating and guarded in all functions.
Maximum Common Mode Voltage:	±500 V dc or peak V ac.
Range Selection:	Manual by front-panel control.
Sample Rate:	Continuously adjustable by front-panel control from 3 readings/second to 1 reading/10 seconds. HOLD position enables external measurement command.

GENERAL (Cont'd)	
Display:	Full four-digits plus overrange digit (gas discharge tubes); automatic decimal point positioning for all functions and ranges; negative polarity indicator; display storage for non-blinking readout; offscale indication.
Operating Temperature:	0°C to +50°C.
Humidity Range:	0 to 80% Relative Humidity (0°C to +35°C). 0 to 70% Relative Humidity (+35°C to +50°C).
Dimensions:	3-1/2" H x 8-1/2" W x 13" D half-rack size portable package, including two side-carry handles.
Weight:	8 lb (3.6 kg) net; 13 lb (6 kg) shipping. Optional battery pack adds 4 pounds.
Power:	115/230 (±10%) V ac, or 100/200 (±10%) V ac, 48-440 Hz, 8 watts maximum.

1.3 OPTIONAL FEATURES

DIGITAL OUTPUTS (OPTION 05)	Nonisolated 8-4-2-1 BCD outputs and recorder control signals with DTL/TTL compatible logic levels. DATA RECORDER COMMON MUST BE ISOLATED FROM MEASUREMENT SOURCE COMMON. *Note: Output signals are not short-circuit-proof.*
Outputs:	4 digits of BCD, and "1" (true) bit for overrange, minus polarity, and print command. Binary "0" (false) = +2.4 to +5 V, 0.1 mA source. Binary "1" (true) = 0 to +0.5 V, 1.8 mA sink.
Inputs:	Single line contact closure to P.S. Common for external READ-ON-DEMAND (single measurement per command), and RECORDER BUSY (inhibit), and STOP (completes measurement in progress).

INTERNAL BATTERY PACK (OPTION 09)	Provides 6 hours of continuous operation between charges; 16-hour recharge cycle through built-in charger. Charges from external power line with instrument in operation. Internal batteries do not increase size of instrument. Three-way battery power switch on rear panel: 1) BATTERY OFF - Operates from power and recharges batteries. 2) BATTERY ON - Operates from internal batteries or external floating +12 V dc source which may be connected internally through rear-panel port. Instrument draws 0.7 A. 3) BATTERY TEST - Checks internal battery condition from front-panel display; also, verifies instrument performance.

CHAPTER 2
INSTALLATION

2.1 INTRODUCTION

The SD Model 7004A Digital Multimeter is shipped in an operational condition and is essentially ready for use as received. This chapter outlines the procedures for initial inspection and installation of the instrument. Instructions for reshipment are also included should the unit be returned to Systron-Donner Corporation for service or repair.

2.2 RECEIVING INSPECTION

Prior to accepting the meter from the shipper, inspect the condition of the shipping container for any indication of freight damage. Any sign of such damage must be noted by both the shipper and receiver and should be reported to the insurance investigator.

Immediately following removal of the instrument from the shipping carton, inspect for possible physical damage incurred during shipment. Check surfaces for scratches or dents and note condition of knobs and connectors. Should any damage be noted, notify your nearest Systron-Donner representative---DO NOT USE THE METER UNTIL INSTRUCTED TO DO SO BY THE REPRESENTATIVE.

2.3 RESHIPMENT

When the instrument is to be repackaged for shipment use the original packing materials. Your Systron-Donner field office can provide materials similar to those used for the original factory packaging, or repackage the instrument following these general instructions:

GENERAL PACKING INSTRUCTIONS

1) Attach a tag to the unit indicating the model number, serial number, name and address of the instrument owner, and a summary of the service or repairs required.

2) Wrap the instrument in heavy paper or plastic prior to placing it into the shipping container.

3) Select a strong carton or wooden box to house the instrument.

4) Use an adequate layer of shock-absorbing material on all sides of the instrument and protect the front panel with additional layers of cardboard. Be certain that there is no movement of the unit within the container.

2.3 RESHIPMENT (Cont'd)

GENERAL PACKING INSTRUCTIONS (Cont'd)

5) Seal the package with strong tape or metal bands.

6) Mark the shipping container "FRAGILE-DELICATE INSTRUMENT" to ensure careful handling.

7) Be certain that all correspondence refers to full instrument nomenclature (model and serial number).

2.4 POWER REQUIREMENTS

Model 7004A Digital Multimeter is equipped with a standard three-conductor power cord which,when plugged into an appropriate power receptacle, grounds the chassis to protect operating personnel from certain electrical hazards. Whenever the power cord is mated to a two-conductor outlet,a cord adapter-plug (properly installed) will provide the same protection.

The instrument operates from either 115 or 230 V at 48 to 440 Hz and consumes approximately 8 watts of power. A LINE switch on the rear panel adapts the unit for the local power line voltage. A 100/200 V tap on the primary of the power transformer is also provided to accommodate certain other power line requirements.

NOTE

The Model 7004A is shipped with a .3 ampere Slo-Blo (115 V operation). If 230 V operation is required, the .3 ampere fuse should be replaced with a .15 ampere Slo-Blo fuse to adequately protect the meter.

2.5 ACCEPTANCE TEST PROCEDURE

The following procedure is performed to verify that no damage has occurred during transit and that the instrument is operative.

NOTE

Prior to performing the Acceptance Test Procedure it is recommended that the used become familiar with the instrument controls described in Chapter 3, OPERATION.

1) Check position of the LINE (115/230 V or 100/200 V) switch and connect ac power cord to an appropriate power source. If Internal Battery Pack (Option 09) is provided, turn BATTERY switch to the OFF position.

2) Turn POWER switch to the ON position; the display will illuminate.

3) Select controls indicated in Table 2.1 and observe the display readings.

TABLE 2.1 ACCEPTANCE TEST PROCEDURE

FUNCTION	RANGE	INPUT	DISPLAY
V	1000	HI/LO/GUARD SHORTED	0000.0±3 DIGITS
V & AC	1000	" " "	" "
mA	1000	" " "	" "
mA & AC	1000	" " "	" "
KΩ	1000	" " "	" "
KΩ	1000	HI/LO OPEN	OFFSCALE READING WITH OFFSCALE INDICATOR ENERGIZED.

4) After completion of the Acceptance Test Procedure, refer to Chapter 3, OPERATION for additional operating information.

CHAPTER 3
OPERATION

3.1 INTRODUCTION

This chapter describes general operation of the Model 7004A Digital Multimeter. Front panel and rear panel functions are described in Tables 3.1 and 3.2. Operating procedures are given in Table 3.3. Also included is information concerning factors which affect measurement accuracy.

3.2 CONTROLS, CONNECTORS AND INDICATORS

3.2.1 Front Panel

Front Panel control functions for Model 7004A are described in this section (see Figure 3.1 and Table 3.1).

TABLE 3.1 FRONT PANEL FUNCTIONS

INDEX	NAME	FUNCTION
1	POWER-OFF (switch)	Applies power to the instrument when turned in the clockwise direction.
2	SAMPLE RATE and HOLD (Potentiometer and Switch)	Controls measurement sample-rate of 3 readings/second to 1 reading/10 seconds as knob is turned in clockwise direction. When in HOLD position, measurement cycle is interrupted until externally commanded by remote programmer ($\overline{\text{Read}}$).
3	HI/LO (Post Connectors)	Input terminals for all measurement functions.
4	GUARD (Post Connector)	Internal guard circuit may be left open (unconnected), or can be bussed to the LO terminal. It may also be connected to an external guard potential. The guard circuit, when utilized, provides increased ac/dc common mode rejection of spurious or undesired signal currents.

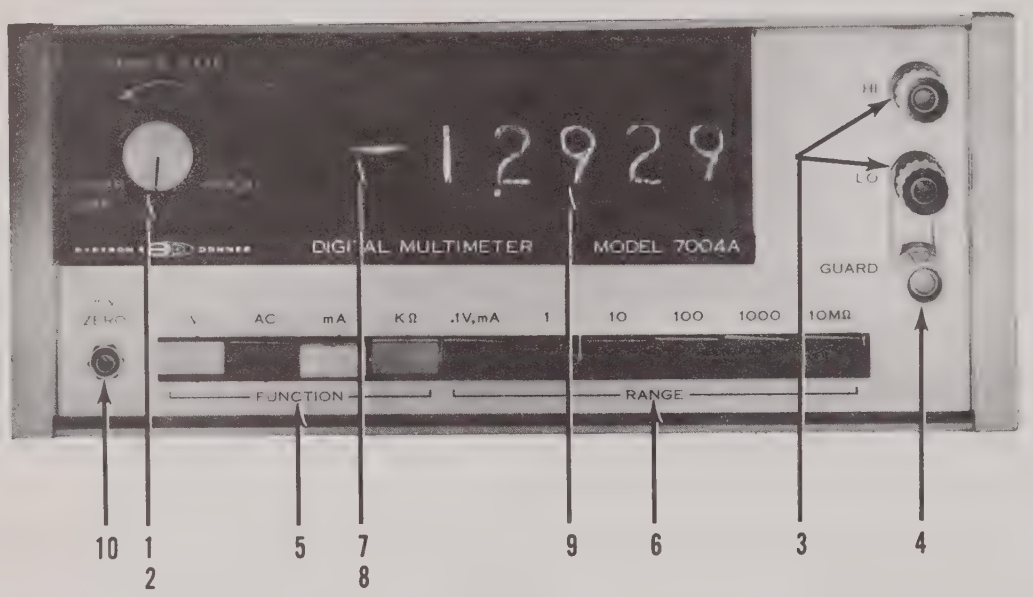


FIGURE 3.1 FRONT PANEL, MODEL 7004A

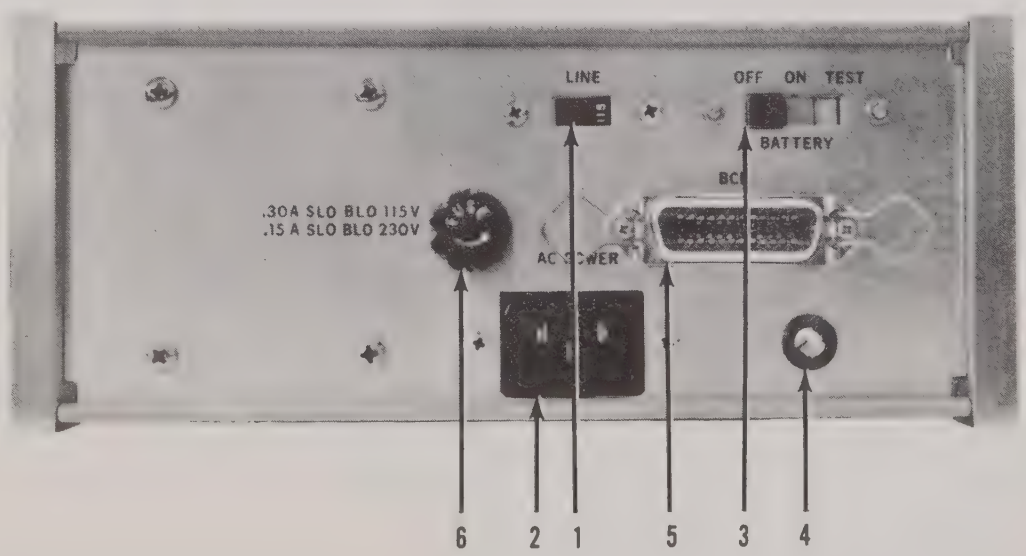


FIGURE 3.2 REAR PANEL, MODEL 7004A

TABLE 3.1 FRONT PANEL FUNCTIONS (Cont'd)

<table>
<tr><td>5</td><td>FUNCTION (Pushbutton Switches)</td><td>Pushbutton switches initiate the following measurements:

FUNCTION — PUSHBUTTON
V (white) — dc voltage — depress V
AC (red) — dc current — depress mA
mA (white) — ac voltage — depress V & AC
KΩ (grey) — resistance — depress KΩ</td></tr>
<tr><td>6</td><td>RANGE</td><td>Pushbutton switches select the following ranges:

RANGE — AC/DC VOLTS — AC/DC CURRENT — KΩ RESISTANCE
.1V,mA — X — X — No
1 — X — X — X
10 — X — X — X
100 — X — X — X
1000 — X — X — X
10 MΩ — No — No — X</td></tr>
<tr><td>7</td><td>Off-Scale Indicator</td><td>LED display, when lighted, indicates an off-scale condition.</td></tr>
<tr><td>8</td><td>Polarity Indicator</td><td>Negative polarity dc measurements are indicated with a (-) sign. Positive polarity levels have no sign indication.</td></tr>
<tr><td>9</td><td>Readout Tubes</td><td>Full four-digit display, with over-range (1), provides full scale readout and 30% overrange capability. Decimal point indication is determined by the range selected.</td></tr>
<tr><td>10</td><td>mV ZERO (Screwdriver Adjustment)</td><td>Fine (screwdriver) adjustment for zeroing low-range mV readings when high-resolution accuracy is desired.</td></tr>
</table>

3.2.2 Rear Panel Functions

Rear Panel control functions for Model 7004A are described in this section (see Figure 3.2 and Table 3.2):

TABLE 3.2 REAR PANEL FUNCTIONS

INDEX	NAME	FUNCTION
1	LINE (Switch)	Slide switch selects 115/230 (±10%) V ac, 48 to 440 Hz operation. Power transformer tap (modification) converts unit to 100/200 (±10%) V ac operation.
2	AC POWER (Three-conductor power receptacle	Power receptacle mates with standard three-conductor power cord (supplied).
3	BATTERY (Switch)	Option 09, Internal Battery Pack-permits field operation of Model 7004A. *OFF Position:* Instrument operates from ac power line while batteries are charging continuously. *ON Position:* Disconnects ac power line; instrument operates from internal battery pack. *TEST Position:* Internal battery voltage is indicated on front-panel readout. Instrument accuracy will be impaired if internal battery pack voltage drops below 11 V dc.
4	EXTERNAL BATTERY (Cable Port)	Provision included for connecting external 12 V dc (nominal) power supply into the instrument. *Do not exceed 13.5 V dc or damage may result.)*
5	BCD Output (Connector)	Option 05, Digital Outputs - provides non-isolated 8-4-2-1 BCD levels and DTL/TTL compatible recorder control logic levels. Mating connector is Amphenol #57-30240 (24 pins).

TABLE 3.2 REAR PANEL FUNCTIONS (Cont'd)

<table>
<tr><td>5</td><td>BCD Output (Cont'd)</td><td>
BCD Connector
Pin Assignments (J201)

<table>
<tr><th>READOUT</th><th>BCD</th><th>PIN</th></tr>
<tr><td>10^3</td><td>$\overline{1}$</td><td>7</td></tr>
<tr><td></td><td>$\overline{2}$</td><td>8</td></tr>
<tr><td></td><td>$\overline{4}$</td><td>19</td></tr>
<tr><td></td><td>$\overline{8}$</td><td>20</td></tr>
<tr><td>10^2</td><td>$\overline{1}$</td><td>5</td></tr>
<tr><td></td><td>$\overline{2}$</td><td>6</td></tr>
<tr><td></td><td>$\overline{4}$</td><td>17</td></tr>
<tr><td></td><td>$\overline{8}$</td><td>18</td></tr>
<tr><td>10^1</td><td>$\overline{1}$</td><td>3</td></tr>
<tr><td></td><td>$\overline{2}$</td><td>4</td></tr>
<tr><td></td><td>$\overline{4}$</td><td>15</td></tr>
<tr><td></td><td>$\overline{8}$</td><td>16</td></tr>
<tr><td>10^0</td><td>$\overline{1}$</td><td>1</td></tr>
<tr><td></td><td>$\overline{2}$</td><td>2</td></tr>
<tr><td></td><td>$\overline{4}$</td><td>13</td></tr>
<tr><td></td><td>$\overline{8}$</td><td>14</td></tr>
</table>

Recorder Control
Pin Assignments(J201)

<table>
<tr><th>FUNCTION</th><th>PIN</th></tr>
<tr><td>P.S. Common (Gnd)</td><td>24</td></tr>
<tr><td>$\overline{\text{Minus Polarity}}$</td><td>21</td></tr>
<tr><td>$\overline{\text{Overrange}}$</td><td>9</td></tr>
<tr><td>$\overline{\text{Print Command}}$</td><td>23</td></tr>
<tr><td>$\overline{\text{Read}}$</td><td>11</td></tr>
<tr><td>$\overline{\text{Stop}}$</td><td>22</td></tr>
<tr><td>$\overline{\text{Inhibit}}$</td><td>10</td></tr>
</table>
</td></tr>
<tr><td>6</td><td>FUSE
(Holder)</td><td>Contains .30 A 3AG Slo-Blo fuse for 115 V operation or .15 A Slo-Blo fuse for 230 V operation.</td></tr>
</table>

3.3 OPERATING PROCEDURES

The general method for operating Model 7004A is indicated in Table 3.3. All inputs are applied between HI/LO terminals; with the GUARD circuit connected to the LO terminal whenever possible.

TABLE 3.3 OPERATING PROCEDURES

FUNCTION	OPERATION	DISPLAY
DC VOLTS	Select V and desired RANGE 0.1, 1, 10, 100, or 1000.	Read display directly in dc volts.
DC CURRENT	Select mA and desired RANGE 0.1, 1, 10, 100, or 1000.	Read display directly in dc milliamperes.
AC VOLTS	Select V and AC with desired RANGE 0.1, 1, 10, 100, or 1000.	Read display directly in ac volts.
AC CURRENT	Select mA and AC with desired RANGE 0.1, 1, 10, 100, or 1000.	Read display directly in ac milliamperes.
RESISTANCE	Select KΩ and desired RANGE 1, 10, 100, 1000, or 10 MΩ	Read display directly in kilohms on the 1, 10, 100, 1000 ranges, and in megohms on the 10 MΩ range.

3.3.1 Sample Rate and Hold Control

This control varies the measurement sample rate over the range of 3 readings/second to 1 reading/10 seconds. When set to the HOLD position, the last reading is displayed until the control is returned to the SAMPLE RATE position; or, a remote command is received on $\overline{\text{READ}}$ line (Pin 11) of connector J202.

3.3.2 Guard Terminal

The instrument contains two isolated inner chassis, top and bottom guard covers connected to the GUARD terminal on the front panel. With the GUARD/LO terminals bussed together, measurement errors due to ac or dc normal mode currents are reduced significantly. Although the GUARD terminal is usually bussed to the LO terminal, in certain applications it may be advantageous to connect it to a separate Guard Voltage.

3.3.3 Overload Protection

Overload protection is provided on all ranges to the extent indicated below:

1) DC VOLTS - ±1000 V (maximum allowable input) on all ranges.

3.3.3 Overload Protection (Cont'd)

2) AC VOLTS - 500 V rms on 10 V, 100 V, 1000 V ranges.
150 V rms on 0.1 V, 1 V ranges.

3) DC CURRENT - 100% above selected range, on all ranges.

4) AC CURRENT - 100% above selected range, on all ranges.

5) RESISTANCE - 130 V rms on 10 kΩ, 100 kΩ, 1000 kΩ, and 10 MΩ ranges. 35 V rms on 1 kΩ range.

3.3.4 mV Zero Adjustment

Located on the Model 7004A front panel is the mV ZERO adjustment. This control permits the user to accurately zero the instrument when low-level, high-resolution measurements are to be made on the 0.1 V range.

Before adjusting this control, allow the instrument to stabilize for at least 1/2 hour after turn-on. Connect a zero-ohm shorting bus across the HI/LO terminals and adjust the mV ZERO control until a reading of .00000 V ±2 counts is obtained.

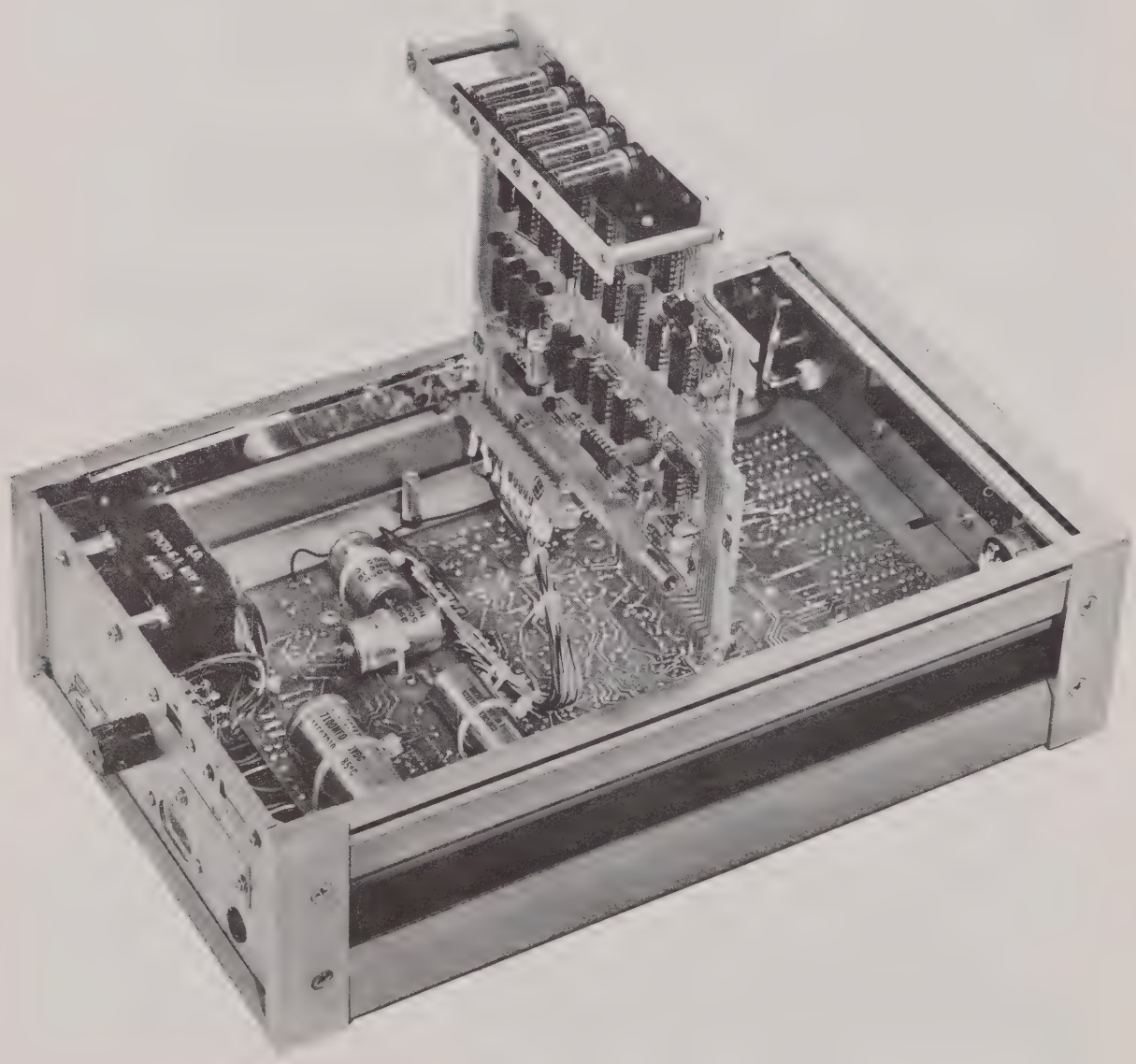


FIGURE 3.3 MOUNTING THE A1 READOUT BOARD FOR ACCESS TO A1 READOUT BOARD AND BOTTOM OF A2 SWITCH BOARD

CHAPTER 4
MAINTENANCE

4.1 INTRODUCTION

This section contains basic maintenance and calibration procedures for maintaining Model 7004A performance parameters. Information in this section includes: Factory Service, Routine Maintenance, Printed-Circuit Board Repair, Test Equipment, and Calibration Procedures.

4.2 FACTORY SERVICE

Whenever a Systron-Donner instrument requires service, the nearest S-D representative should be contacted. He can provide field service,or arrange factory service when necessary. Address all inquiries concerning service, operation, or application to your nearest sales representative; or, to Sales Manager:

SYSTRON-DONNER CORPORATION
CONCORD INSTRUMENT DIVISION
10 Systron Drive
Concord, California 94518
Phone: (415) 676-5000
TWX: 910-481-9479
Cable: SYSTRONDONNER

4.3 ROUTINE MAINTENANCE

A regular program for maintenance and inspection every four to six months is recommended for this unit. As part of these regular procedures, the instrument should be checked in the following manner:

1) Disconnect ac power and remove the top and bottom covers.

2) Make a thorough visual inspection of all wiring and cables. Check for frayed, loose, or burned wires.

3) Check the physical integrity of all components. Look for burned or cracked components, loose solder connections, leakage of insulation compounds, and general physical damage. When a printed-circuit board contains integrated-circuit packages, ensure that all packages are firmly mounted. Never unnecessarily remove and replace a package.

4) Check front panel switches and controls for loose or broken terminals, sticking shafts, etc.

4.3 ROUTINE MAINTENANCE (Cont'd)

5) If the internal panel surfaces and components have accumulated an excessive amount of dust, use a soft brush and low-pressure stream of air to remove the foreign material.

CAUTION

Do not clean P.C. boards or small internal components with a stiff brush or solvents since damage to the circuits may result. A high-powered vacuum cleaner device should never be used on small internal components.

6) Wipe the external surfaces of the instrument with a soft, damp cloth to remove dirt, fingerprints, and other foreign materials.

7) Replace the top and bottom covers and reconnect ac power. Perform the operational test procedures given in Section 4.6. If performance does not match or exceed the specifications listed in Chapter 1 of this manual, corrective maintenance is in order.

4.4 PRINTED-CIRCUIT BOARD REPAIR

When replacing integrated circuits or other electronic components soldered to printed-circuit boards, the procedures indicated below must be followed or damage to the board may result:

1) Determine by troubleshooting techniques, which integrated circuit or discrete component(s) has failed.

2) Remove the defective component(s) from the board by cutting the pins or leads with a small diagonal clipping tool. (Always remove and replace the entire component.)

3) Apply heat (40-50 W soldering iron) sparingly to each of the cut pins or leads and remove from the board; clean the hole(s) with a toothpick or solder suction tool.

4) Form the tinned leads of the replacement part and insert in the printed circuit holes; solder, then trim leads to extend 1/16-inch beyond the back surface of the board. (Use only 63-37 solder with maximum 1/16-inch diameter.)

CAUTION

Always trim semiconductor leads only after soldered installation is complete. This procedure greatly lessens the possibility of component failure due to shock-wave damage caused by the trimming tool.

4.4 PRINTED CIRCUIT BOARD REPAIR (Cont'd)

5) When soldering semiconductor devices and all small components, be sure to use a heat sink tool or long-nosed plier connected to the component lead(s) while each is being soldered. Allow the soldered connection to cool before removing the heat sink.

6) Do not use solvents on the printed-circuit traces. After soldering, leave rosin flux on the P.C. board.

4.5 TEST EQUIPMENT

Listed in Table 4.1 is the inventory of test equipment required for maintenance and calibration of the Model 7004A Digital Multimeter. In the event these specific items are not available, units of equal, or greater accuracy and capability may be used.

TABLE 4.1 TEST EQUIPMENT FOR MODEL 7004A

NOMENCLATURE	TYPE	USAGE
DC Voltage/Current Calibrator	Fluke Model 382A & 332B	dc voltage & current calibration
AC Voltage Calibrator	HP Model 745A (Use 0.1% resistors for ac current calibration)	ac voltage & current calibration
Resistance Standard	ESI Model RS925C	resistance calibration
Digital Voltmeter	Systron-Donner Model 7205	calibration & troubleshooting
Oscilloscope	Tektronix Model 535 with Type D Plug-in	calibration & troubleshooting

4.6 CALIBRATION PROCEDURES

This section contains step-by-step calibration procedures for the Model 7004A. Perform these procedures in listed order since earlier steps may affect later ones.

Test and calibration tolerances listed in these procedures do not include specification variances of the test/calibration equipments listed in Table 4.1.

4.6 CALIBRATION PROCEDURES (Cont'd)

Unless otherwise indicated, all calibration procedures may be conducted while at room ambient temperature and at nominal power-line voltage and frequency.

For best results use high-quality test leads of 36-inch maximum length. Undesirable noise may be eliminated during the calibration procedures by grounding the LO/GUARD terminals to the test/calibration equipment.

4.6.1 Power Supply Voltages

1) Remove bottom instrument cover (rear end-trim; slide cover off), apply power, and check power supply voltages (bottom side, P.C. board) as follows:

TABLE 4.2 POWER SUPPLY VOLTAGES

VOLTAGE	TEST POINT	ADJUSTMENT	TOLERANCE
+17 V dc	Green	Fixed	Nominal
-18 V dc	Yellow	Fixed	Nominal
Ground	Red/Black	-	-

2) Turn OFF power; replace instrument cover.

4.6.2 Calibration

1) Apply power to instrument and allow at least 1/2-hour warm-up.

2) Remove bottom instrument cover

3) TRANSFORMER UNBALANCE COMPENSATION: Compensation for transformer unbalance has been made at the factory to eliminate display "noise" or uncertainty. This compensation is adequate for most ac power sources at the point of manufacture. When this unit is used with differing or special power sources, it may be desirable to rebalance the power transformer. This may be done using the following procedure:

   Short across the HI, LO, and GUARD inputs. Remove side panel cover and set FUNCTION switch to V and RANGE switch to .1 V, mA. Monitor ripple voltage across Main Amplifier output TP-6, with respect to LO terminal. Connect a capacitor across guard post 22 and Main Amplifier supply post 23 or 24 for a minimum output. The value of the capacitor may vary between 10 pF to 400 pF (typical value is 56 pF). The output

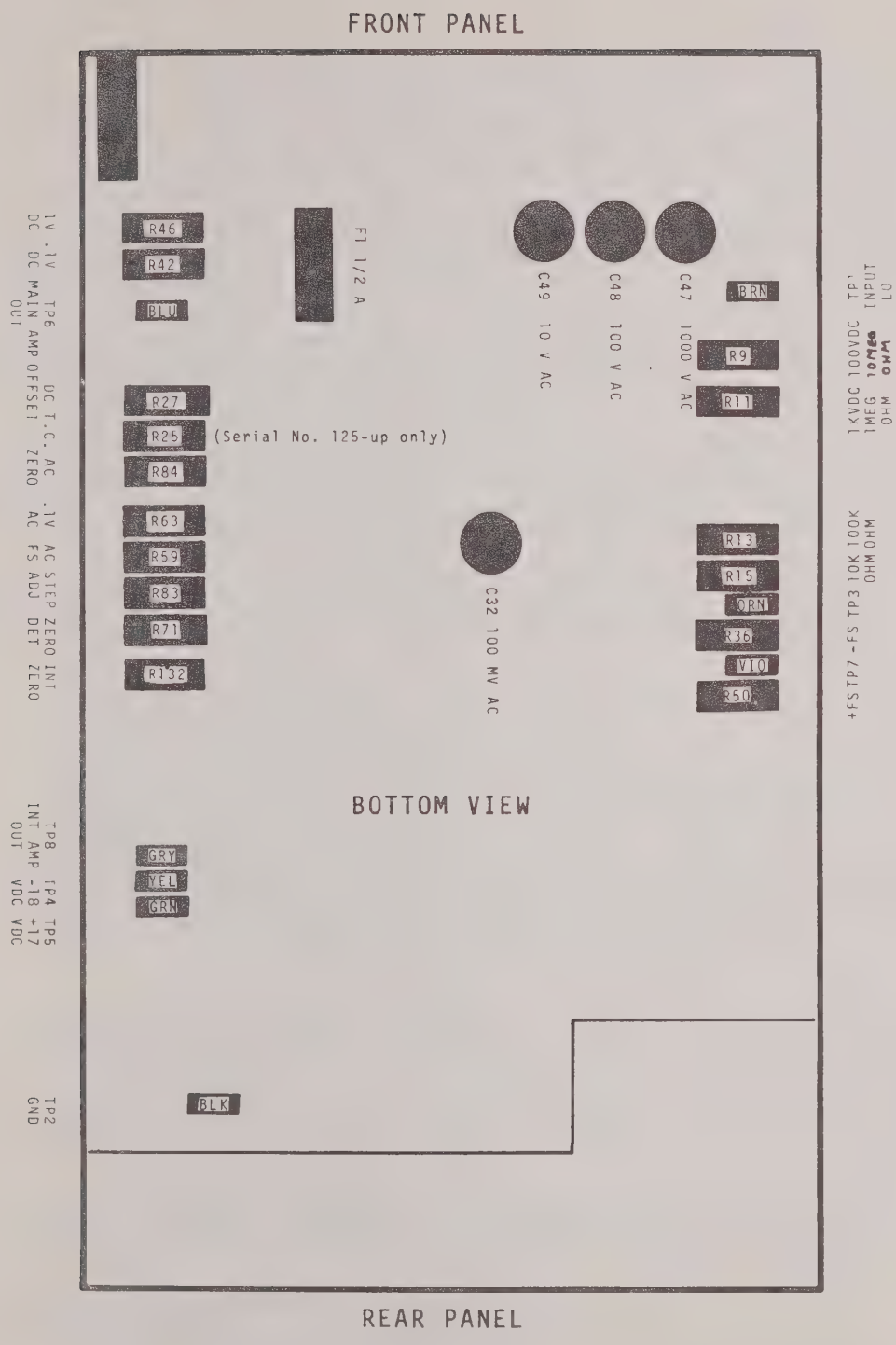


FIGURE 4.1 LOCATION, CALIBRATION CONTROLS

3) TRANSFORMER UNBALANCE COMPENSATION: (Cont'd)

should be minimum but no more than 50 mV p-p. Occasionally the transformers are well balanced and may not require any capacitance.

With the instrument still on the .1 V DC RANGE, adjust the DC OFFSET potentiometer A2R27 to adjust the main amplifier output to 0.0 V ±5 mV dc. Measure the voltage with a DVM between the INPUT LOW terminal, and the MAIN AMP OUT test point A2TP6. If the DC OFFSET potentiometer does not have sufficient range, adjust the T.C. potentiometer A2R25 toward the center of its range or until a zero can be obtained.

4) INTEGRATOR ZERO: Place the FUNCTION and RANGE switches to the 10 V DC position. Monitor the integrator output, INT AMP OUT, at A2TP8 with respect to INPUT LOW with an oscilloscope. Adjust the INT ZERO potentiometer A2R132 until a minimum amplitude ramp is observed.

The ramp slope should increase in either a + or - direction depending on potentiometer rotation from the proper zero setting.

5) DETECTOR ZERO: Adjust ZERO DET potentiometer A2R71 until the polarity sign flashes on and off intermittently.

6) STEP ADJUST: Remove short across the input and apply +10 mV dc (10 counts). Adjust STEP ADJ potentiometer A2R83 to read +10 counts. Next, apply -10 mV dc (10 counts). The readout should display -10 counts. If not, adjust ZERO DET potentiometer A2R71 until the + and - readings are equal, then readjust STEP ADJ potentiometer A2R83 until ±10 counts are obtained with a ±10 mV dc input.

7) INPUT MAIN AMPLIFIER ZERO: This adjustment is done in two parts. First DC OFFSET is adjusted for minimum output at room temperature and then the T.C. pot[1] (Temperature Compensation) is calibrated at 75°C. In order to obtain the proper setting, the procedure described below should be followed:

   a) Place the FUNCTION and RANGE switches in V and .1V,mA position, and SAMPLE RATE at maximum. Short the HI and LO input terminals and GUARD together.

   b) Set the mV ZERO pot (front panel control) to the electrical center of its range. Procedure: Adjust to both mechanical extremes observing the maximum zero offset in each direction. Readjust to the number midway between the extremes.

1 This is factory adjusted and need not be performed unless parts have been replaced in the Input Main Amplifier.

7) INPUT MAIN AMPLIFIER ZERO: (Cont'd)

c) Set the T.C. pot A2R25 to the electrical center of its range. Procedure: Adjust to both mechanical extremes observing the maximum zero offset in each direction. Readjust to the number midway between the extremes.

d) Readjust DC OFFSET potentiometer A2R27 to zero the instrument.

e) Adjust the T.C. pot A2R25 to produce a reading of +.00200 ±1 count.

f) Place a thermal probe, stabilized at 75°C, on dual FET A2Q1 for a period of approximately one minute.

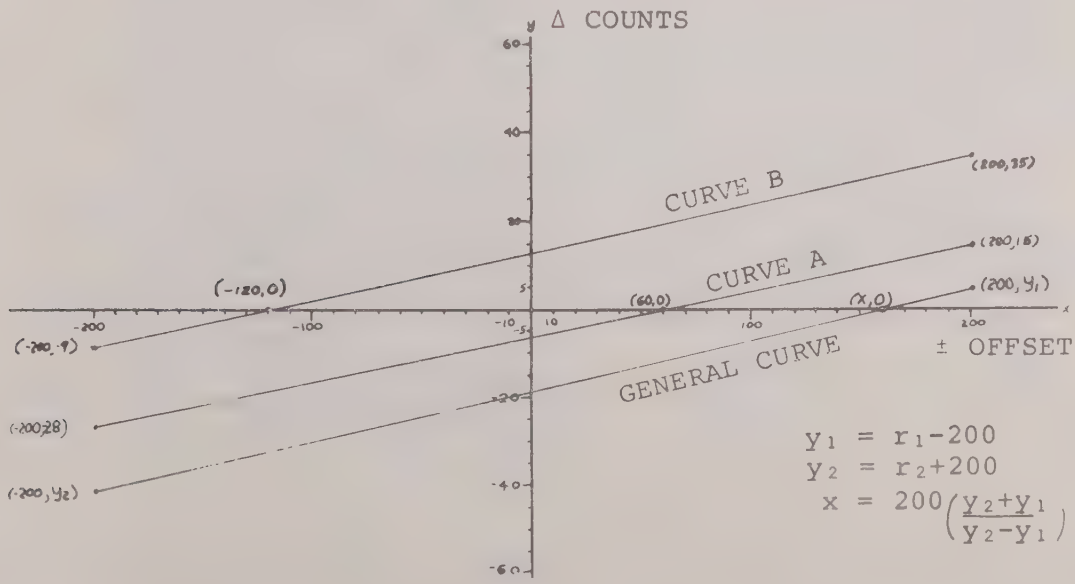
g) Remove the thermal probe and record the first reading (r_1) after the probe is removed. (Typically more positive than +.00200)

h) Adjust the T.C. pot A2R25 to produce a reading of -.00200 ±1 count. Observe that the FET has cooled to approximately room temperature and that the reading remains stable.

i) Place the 75°C thermal probe on Dual FET A2Q1 again for approximately one minute.

j) Remove the thermal probe and record the first reading (r_2) after removal (typically more negative than -.00200).

k) Determine the CHANGE of each reading (y_1,y_2) and plot the points on linear graph paper with XY scales. Two typical curves are plotted in the example to demonstrate positive and negative compensation settings.



$y_1 = r_1 - 200$

$y_2 = r_2 + 200$

$x = 200\left(\frac{y_2+y_1}{y_2-y_1}\right)$

FIGURE 4.2 TYPICAL TEMP. COMP. GRAPH

4.6.2 Calibration (Cont'd)

7) INPUT MAIN AMPLIFIER ZERO: (Cont'd)

l) Draw a straight line curve through the two points, and note the point of intersection with the ±OFFSET scale, x-axis.

m) Adjust T.C. pot A2R25 to produce a reading equal to the number of counts shown by the intersection on the graph. In the above example the reading should be +.00060 for Curve A and -.00120 for Curve B.

n) Readjust DC OFFSET pot A2R27 to zero the instrument.

o) Verification of proper temperature compensation may now be performed. Observe the reading at .00000 ±1 count, if not, adjust the front panel mV ZERO adjustment to produce this reading. Place the 75°C thermal probe on Dual FET Q1 for approximately one minute. Remove the probe and observe the reading is still .00000 ±20 counts. This procedure will typically compensate the FET to ±5 counts (±50 μV) for a 50°C change in temperature. If the 25°C to 75°C zero stability of the FET is not less than ±20 counts after compensation, it may be due to improper performance of the compensation procedure, or a defective device with excessive gate leakage current.

8) +FS (TP7-violet): Apply +10 V dc across the inputs and adjust +FULL SCALE potentiometer A2R50 to read 10.000 ±1 count.

9) -FS (TP3-orange): Apply -10 V dc across the inputs and adjust -FULL SCALE potentiometer A2R36 to read -10.000 ±1 count.

10) OHMS CALIBRATION: Set FUNCTION switch to KΩ and select RANGE as indicated in Table 4.3:

TABLE 4.3 RESISTANCE CALIBRATION

RANGE	CALIBRATOR INPUT	ADJUST	DISPLAY	INITIAL ADJUSTMENT	FINAL CALIB
1	1 kΩ	No adjustment	1.0000	±11 counts	±11 counts
10	10 kΩ	A2R15	10.000	±1 count	±11 counts
100	100 kΩ	A2R13	100.00	±1 count	±11 counts
1000	1000 kΩ	A2R11	1000.0	±1 count	±11 counts
10 MΩ	10 MΩ	A2R9	10.000	±1 count	±11 counts

11) DC VOLTAGE CALIBRATION: Set FUNCTION switch to V and select RANGE as indicated in Table 4.4:

TABLE 4.4 DC VOLTAGE CALIBRATION

RANGE	CALIBRATOR INPUT	ADJUST	DISPLAY
.1	±100 mV	A2R42	.10000 ±2 counts
1	±1 V	A2R46	1.0000 ±1 count
10	±10 V	Same as 8) & 9)	10.000 ±1 count
100	±100 V	A2R9	100.00 ±1 count
1000	±1000 V	A2R11	1000.0 ±1 count

NOTE

If adjustment of A2R11 or A2R9 is necessary, the Resistance ranges may be slightly affected, but these will continue to be within specified tolerances. Also, do not attempt at this point, to readjust the Resistance ranges back to ±1 count since the DC Voltage calibration will then be affected.

12) AC VOLTAGE CALIBRATION: *(Perform DC VOLTAGE CALIBRATION first then replace bottom cover).*

a) AC ZERO: Set FUNCTION switches to V and AC. Set RANGE switch to 0.1 V mA. Short the HI/LO input terminals with a bus jumper. (Do not use long test leads which will pick up noise.) Adjust AC ZERO A2R84 so that display reads a minimum, but no higher than 15 counts.

b) Apply a 0.1 V rms, 200 Hz input signal from the AC Voltage Calibrator across the HI/LO input terminals. Slide back bottom cover and adjust A2R63 until the readout is .10000 ±1 count. Replace bottom cover.

c) Apply a 0.1 V rms, 20 kHz input signal across the HI/LO input terminals. Slide the bottom cover back and, through the vent holes, adjust frequency compensation capacitor A2C32 until the readout is .10000 ±1 count.

d) Set the RANGE switch to the 1 V range. Apply a 1.0 V rms, 200 Hz input signal across the HI/LO input terminals. Slide back bottom cover and adjust A2R59 until the readout is 0.9995 ±2 counts. Replace bottom cover.

e) Set the RANGE switch to the 10 V range. Apply a 10 V rms, 200 Hz input signal across the HI/LO input terminals. Observe that the readout is 10.000 ±22 counts.

f) Apply a 10 V rms, 20 kHz input signal across the HI/LO input terminals. Through the vent holes, adjust attenuator frequency compensation capacitor A2C49 for a reading of 09.990 ±2 counts.

4.6.2 Calibration (Cont'd)

12) AC VOLTAGE CALIBRATION: (Cont'd)

g) Set the RANGE switch to the 100 V range. Apply a 100 V rms, 200 Hz input signal across the HI/LO input terminals. Observe that the readout is 100.00 ±22 counts.

h) Apply a 100 V rms, 20 kHz input signal across the HI/LO input terminals. Through the vent holes, in the bottom cover, adjust attenuator frequency compensation capacitor A2C48 for a reading of 099.90 ±2 counts.

i) Set the RANGE switch to the 1000 V range. Apply a 500 V rms, 200 Hz input signal across the HI/LO input terminals. Observe that the readout is 0500.0 ±12 counts.

j) Apply a 500 V rms, 10 kHz input signal across the HI/LO input terminals. Through the vent holes, in the bottom cover, adjust attenuator frequency compensation capacitor A2C47 for a reading of 0499.5 ±1 count.

k) In the event that an AC Voltage Calibrator with an output capability of 500 V rms is not available, the following procedure will provide adequate frequency compensation. Apply a 100 V rms, 200 Hz input signal across the HI/LO input terminals. Observe that the readout is 0100.0 ±4 counts.

l) Apply a 100 V rms, 10 kHz input signal across the HI/LO input terminals. Through the vent holes, in the bottom cover, adjust attenuator frequency compensation capacitor A2C47 to observe a reading of 0099.8 ±1 count.

13) DC/AC CURRENT CALIBRATION:

a) DC CURRENT: Set FUNCTION switch to mA and RANGE switch as indicated below. Connect DC Current Calibrator output across the HI/LO input terminals. Observe display, no adjustment is required.

TABLE 4.5 DC CURRENT CALIBRATION

RANGE	CALIBRATOR INPUT	DISPLAY	
.1	±100 µA	.10000	±14 counts
1	±1 mA	1.0000	±11 counts
10	±10 mA	10.000	±11 counts
100	±100 mA	100.00	±11 counts
1000	±1000 mA	1000.0	±11 counts

b) AC CURRENT: Set FUNCTION switch to AC and mA; then, repeat Step 13a. Use AC Current Calibrator. If not available, apply ac voltage across precision resistors to obtain proper currents.

13) DC/AC CURRENT CALIBRATION: (Cont'd)

TABLE 4.6 AC CURRENT CALIBRATION

RANGE	CALIBRATOR INPUT	DISPLAY	
.1	100 µA	.10000	±52 counts
1	1 mA	1.0000	±32 counts
10	10 mA	10.000	±32 counts
100	100 mA	100.00	±32 counts
1000	1000 mA	1000.0	±32 counts

CHAPTER 5
THEORY OF OPERATION

5.1 INTRODUCTION

This chapter presents the theory of operation for the Model 7004A Digital Multimeter. Included in this description is a general presentation of dual-slope integration, followed by a detailed discussion of the A1, Count Chain & Readout Board, and the A2, Switch Board.

5.2 DUAL-SLOPE INTEGRATION

The method of dual-slope integration, as used in the Model 7004, is a two-step analog to digital measurement technique. The first step is characterized by an ultra-high impedance input operational amplifier which provides extremely high input impedance plus gain on the lowest ranges. At the start of the measurement period, control circuits connect the amplifier output to the integrator, remove the short from the integrating capacitor, and open the gate so that pulses will pass from the oscillator to the counter. Since the integrating capacitor was just shorted, the integrator output starts from zero. This output is a ramp with slope and direction proportional to the instantaneous amplitude and polarity of the input voltage. The integration continues until 10,000 counts from the oscillator have been accumulated. With an oscillator frequency of 100 kHz this occurs in 1/10th of a second.

At this time the second step of the measurement cycle begins. The integrator input switches to the reference supply, the polarity of which is chosen to be opposite that of the input voltage. The counter continues to count while the reference voltage now drives the integrator back to zero. The slope of the decreasing voltage from the integrator is proportional to the reference voltage and the time required to drive the integrator back to zero is direct proportional to the unknown input. When the integrator reaches zero the gate is closed and the counter is stopped. This count is now numerically equal to the unknown input voltage and is transferred into memory and displayed as the final answer.

Several features of Dual-Slope Integration should be noted:

1) The same integrator is used during both halves of the measurement cycle which essentially eliminates the problems usually inherent in integrator circuits such as component aging and temperature drift. It is only necessary for the integrator to maintain the same characteristics from the first to the second half of the measurement cycle.

5.2 DUAL-SLOPE INTEGRATION (Cont'd)

2) The same clock oscillator is used during both halves of the measurement cycle; its frequency need only remain constant for a very short period.

3) The input is always compared to an internal reference for each measurement.

5.3 CIRCUIT DESCRIPTIONS

Each section in this chapter contains assembly information composed of a circuit description, an assembly drawing, a schematic, and a parts list. Only standard assemblies are described. The Block Diagram, Final Assemblies and Final Assembly parts list preceed the "A" numbered assembly packages. Table 5.1 Drawing Index Information lists the contents of this chapter.

The sections are numbered in a sequence as follows:

EXAMPLE: A2-1

A2 = Assembly

1 = Page number of the assembly

TABLE 5.1 DRAWING INDEX INFORMATION

Ref	Description	Drawing	Page #
	Block Diagram	037190-7-1	5-9
	Final Assembly	037190-4-1	5-10
	Test Assembly	037197-4-1	5-11
	Front Panel Assembly	037198-4-1	5-12
	Rear Panel Assembly	037747	5-13
	Specification Transformer Assembly	037470-6-1	5-14
	Final Assembly Parts List	037190	5-15
	Test Assembly Parts List	037197-4-1	5-17
	Front Panel Assembly Parts List	037198-4-1	5-19
	Rear Panel Assembly Parts List	037747	5-20
A1	Count Chain and Readout Assembly	037215-4-1	A1-3
	Schematic	037215-7-1	A1-4
	Parts List	037215-4-1	A1-5
	Tube Retainer Assembly	037206-4-1	A1-15
	Parts List	037206-4-1	A1-16
	Minus Bracket Assembly	037235-4-1	A1-17
	Parts List	037235-4-1	A1-18
A2	Switch Assembly	037217-4-1	A2-5
	Schematic (Sheet 1 of 2)	037217-7-1	A2-6
	Schematic (Sheet 2 of 2)	037217-7-1	A2-7
	S1-S10, Switch Wiring Sub Assembly	037217-3-1	A2-8
	Parts List	037217-4-1	A2-9

5.4 PARTS LIST COLUMN DESCRIPTION

Each column in the parts list provides specific information relating to the listed parts as follows:

1) REFERENCE DESIGNATION: P.C. assemblies are listed in numerical order. Reference numbers applicable to these assemblies are listed in alpha-numeric order.

2) NAME OF COMPONENT AND DESCRIPTION: Component names and specifications are provided in these columns and include: value, tolerance, wattage rating, working voltage, construction, etc.

3) MANUFACTURER'S CODE: H4-2 Federal Supply Code numbers are listed to identify component manufacturers. A Manufacturer's Index is provided in this chapter for cross-reference.

4) MANUFACTURER'S PART NUMBER: True manufacturer part numbers are listed in this column.

5) NUMBER OF TIMES USED: This quantity, appearing after an item entry, indicates the number of times the component is used in that assembly.

6) S-D STOCK NUMBER: The Systron-Donner stock number is listed in this column.

5.5 MANUFACTURER'S INDEX

TABLE 5.2 CODE-TO-NAME CROSS-REFERENCE

Code	Name	Address
00779	Amp Inc.	P.O. Box 3608, Harrisburg, P.A. 17105
00853	Sangamo Electric Co. S. Carolina Div.	P.O. Box 128, Pickens, S. Carolina 29671
01121	Allen-Bradley Co.	1201 South 2nd Street, Milwaukee, Wis. 53204
01295	Texas Instruments Inc. Semiconductor and Components Div.	13500 N. Central Expressway, Dallas, Texas 75231
02660	Amphenol Corp.	2801 S. 25th Ave., Broadview, Ill. 60153
02735	RCA Corp., Solid State Div.	Route 202, Somerville, N.J. 08876
03508	General Electric Co. Semiconductor Products Dept.	Electronics Park, Syracuse, N.Y. 13201
03877	Transitron Electronic Corp.	168-186 Albion St., Wakefield, Ma. 01880
03888	Pyrofilm Corp.	60 S. Jefferson Road, Whippany, N.J. 07981

TABLE 5.2 CODE-TO-NAME CROSS-REFERENCE (Cont'd)

Code	Name	Address
04264	Circon Component Corp.	Santa Barbara Municipal Airport, Goleta, Ca. 93017
04713	Motorola Semiconductor Products Inc.	5005 East McDowell Road, Phoenix, Arizona 85008
05574	Viking Industries Inc.	21001 Nordhoff, Chatsworth, Ca. 91311
06383	Panduit Corp.	17301 Ridgeland, Tinley Park, Il. 60477
06540	Amatom Electronic Hardware Div. of Mite Corp.	81 Rockdale Ave., New Rochelle, N.Y. 10806
06811	Systron-Donner Corp.	10 Systron Drive, Concord, Ca. 94518
07263	Fairchild Camera and Instrument Corp., Semiconductor Div.	313 Frontage Rd., Mountain View, Ca. 94040
08289	Blinn Delbert Co. Inc.	1678 Mission Blvd., Pomona, Ca. 91766
08547	Wallace R. G. Co. Inc.	2301 E Del Amo Blvd., Compton, Ca. 90220
11897	Plastiguide Mfg. Corp.	1757-59 Stanford, Santa Monica, Ca. 90406
12014	Chicago Rivet and Machine Co.	950 S. 25th Ave., Bellwood, Il. 60104
12406	Elpac Inc.	18651 Von Karman Ave., Irvine, Ca. 92664
12517	Component Research Co. Inc.	1717 19th St., Santa Monica, Ca. 90404
13103	Thermalloy Co.	8717 Diplomacy Row, Dallas, Texas 75247
13715	Fairchild Camera and Instrument Corp. Semiconductor Div. Diode Plant	4300 Redwood Hwy., San Rafael, Ca. 94903
13862	Alasco Rubber and Plastics Corp.	839 Malcolm Rd., Burlingame, Ca. 94010
15818	Teledyne Inc. Amelco Semiconductor Div.	P.O. Box 1030, Mountain View, Ca. 94042
15915	Tepro of Florida Inc.	375 Patricia Ave., Dunedin, Florida 33528
15933	Systron-Donner Corp. Datapulse Div.	10150 W Jefferson Blvd., Culver City, Ca. 90230
18612	Vishay Resistor Products Div. Vishay Intertechnology	68 Lincoln Hwy., Malvern, Pa. 19355

TABLE 5.2 CODE-TO-NAME CROSS-REFERENCE (Cont'd)

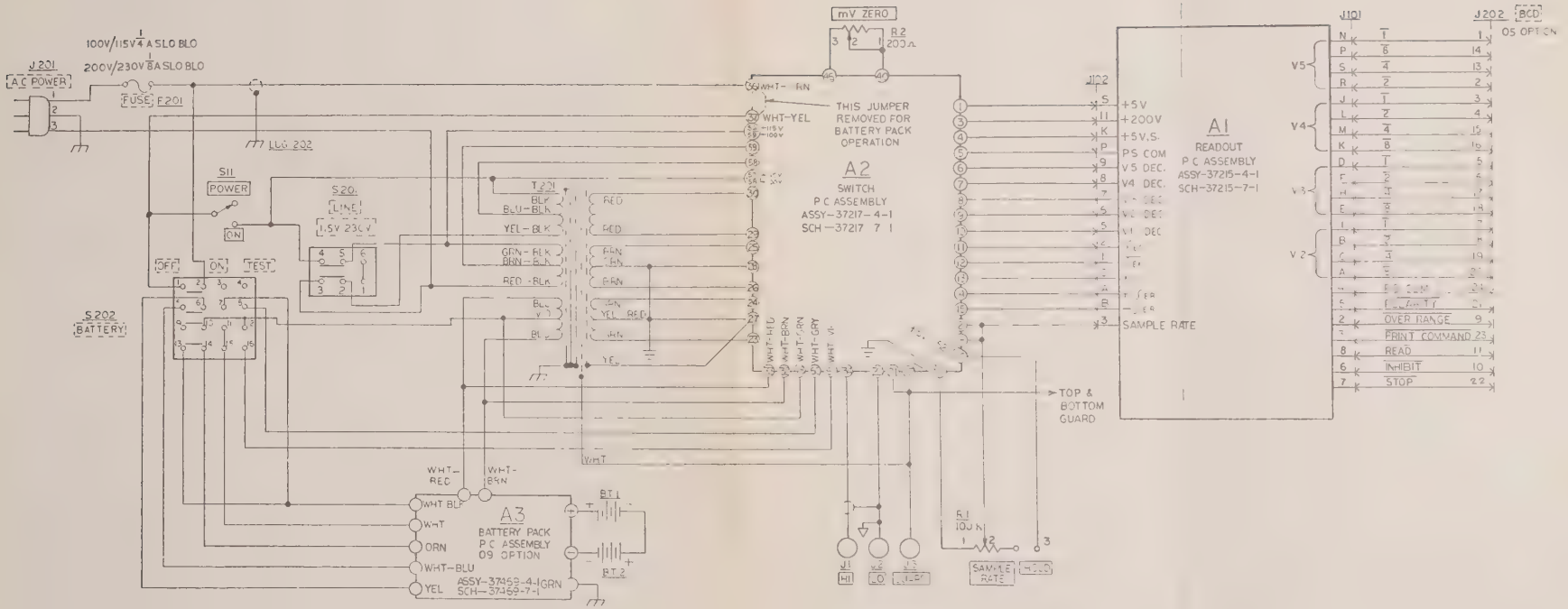
Code	Name	Address
19701	Electra/Midland Corp.	P.O. Box 760, Mineral Wells, Texas 76067
21604	Buckeye Stamping Co.	555 Marion Road, Columbus, Ohio 43207
23172	Alpha Wire Corp.	2815 Columbia Ave., Torrance, Ca. 90503
24655	General Radio	300 Baker Ave., Concord, Ma. 01742
25244	Globe-Union Inc.	P.O. Box 591, Milwaukee, Wi. 53201
27014	National Semiconductor Corp.	2950 San Ysidro Way, Santa Clara, Ca. 95051
27264	Molex Products Co.	5224 Katrine Ave., Downers Grove, Ill. 60515
28520	Heyman Mfg. Co.	147 N. Michigan Ave., Kenilworth, N.J. 07033
31433	Union Carbide Corp. Materials Systems Div. Components Dept.	Highway 276 S.E., Greenville, S.C. 29606
32159	West-Cap Arizona	2201 E. Elvira Road, Tucson, Arizona 85706
32767	Griffith Plastic Products Co.	1027 California Drive, Burlingame, Ca. 94010
50579	Litronix Inc.	19000 Homestead Road, Cupertino, Ca. 95014
56289	Sprague Electronic Co.	North Adams, Mass. 01247
70903	Belden Corp.	415 S. Kilpatrick, Chicago, Ill. 60644
71279	Cambridge Thermonic Corp.	445 Concord Ave., Cambridge, Ma. 02138
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	2536 W. University St., St. Louis, Mo. 63017
71590	Globe-Union Inc. Centralab Div.	P.O. Box 591, Milwaukee, Wis. 53201
71744	Chicago Miniature Lamp Works	4433 Ravenswood Ave., Chicago, Ill. 60640
72136	Electro Motive Mfg. Co. Inc.	South Park and John Sts., Willimantic, Conn. 06226
73138	Beckman Instruments Inc. Helipot Div.	2500 Harbor Blvd., Fullerton, Ca. 92634
73734	Federal Screw Products Inc.	3917 N. Kenzie Ave., Chicago, Ill. 60618

TABLE 5.2 CODE-TO-NAME CROSS-REFERENCE (Cont'd)

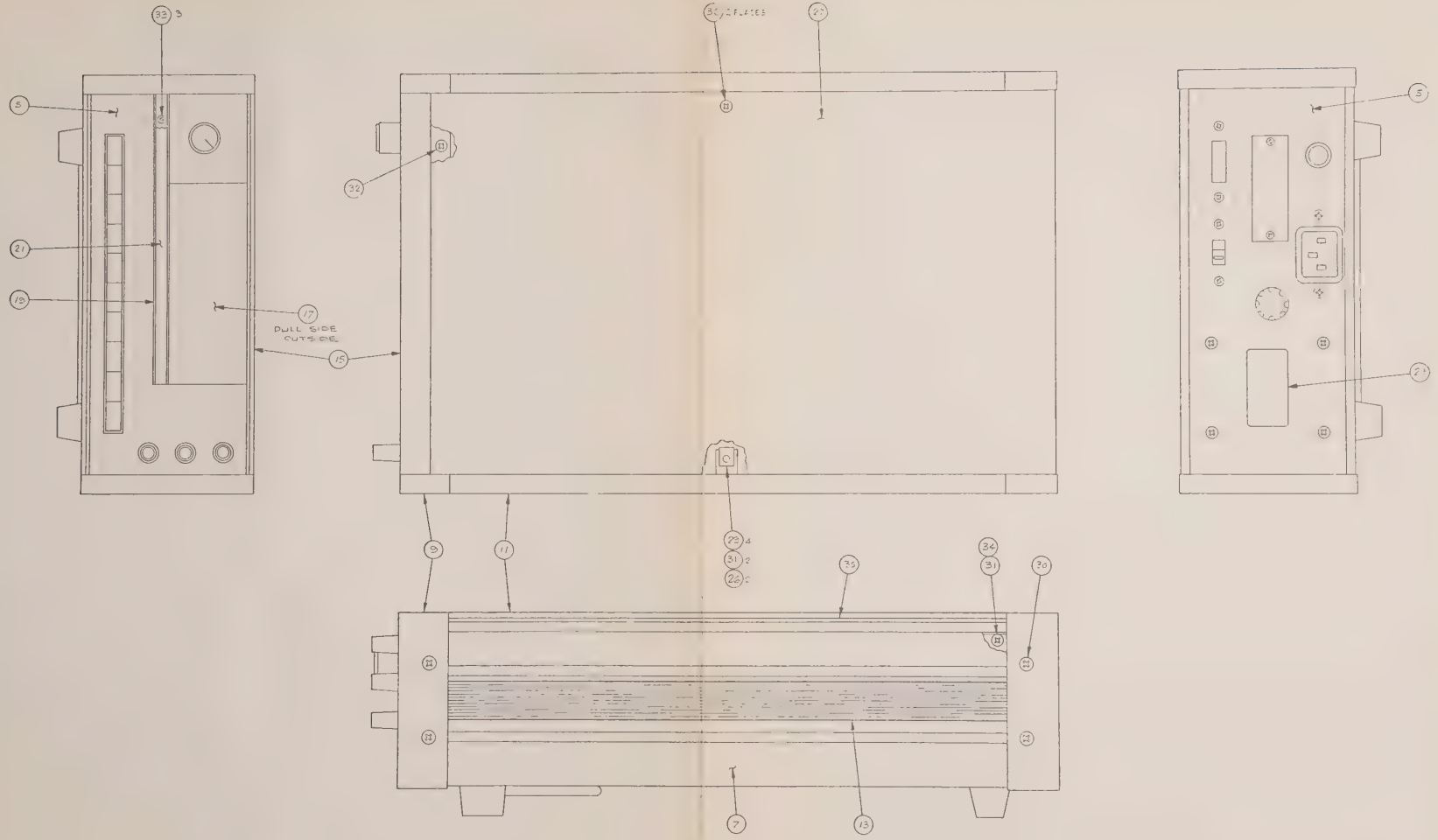
Code	Name	Address
73899	J F D Electronics Corp.	15th at 62nd St., Brooklyn, N.Y. 11219
74970	Johnson, E.F., Co.	299 10th Ave. S.W., Waseca, Mn. 56093
75042	T R W Electronic Components IRC, Philadelphia Div.	401 N. Broad St., Philadelphia, Pa. 19108
75915	Littlefuse Inc.	800 E. Northwest Hwy., Des Plains, Ill. 60016
76381	Minnesota Mining and Mfg. Co.	3 M Center, St. Paul, Mn. 55101
76545	Mueller Electric Co.	1583 East 31st St., Cleveland, Oh. 44114
78189	Illinois Tool Works Inc. Shakeproof Div.	St. Charles Road, Elgin, Ill. 60126
78553	Tinnerman Products Inc.	8700 Brookpark Rd., Cleveland, Oh. 44129
79061	Vaco Products Co.	510 N. Dearborn, Chicago, Ill. 60610
79963	Zierick Mfg. Co.	Radio Circle, Mt. Kisco, N.Y. 10549
80294	Bourns Inc.	1200 Columbia Ave., Riverside, Ca. 92507
80477	Adams Rite Mfg. Co.	540 W. Chevy Chase Dr., Glendale, Ca. 91204
82389	Switchcraft Inc.	5555 N. Elston Ave., Chicago, Ill. 60630
83330	Smith Herman H Inc.	812 Snediker Ave., Brooklyn, N.Y. 11207
83781	National Electronics Inc.	P.O. Box 269, Geneva, Ill. 60134
84411	T R W Capacitor Div.	112 W. First St., Ogallala, Ne. 69153
86797	Rogan Bros. Inc.	8031 N. Monticello, Skokie, Ill. 60076
86928	Seastrom Mfg. Co. Inc.	701 Sonora Ave., Glendale, Ca. 91201
88245	Litton Precision Products Inc., Useco Div. Litton Industries	13536 Saticoy St., Van Nuys, Ca. 91409
91418	Radio Materials Co.	4242 W. Bryn Mawr, Chicago, Ill. 60646
91506	Augat Inc.	33 Perry Ave., Attleboro, Ma. 02703

TABLE 5.2 CODE-TO-NAME CROSS-REFERENCE (Cont'd)

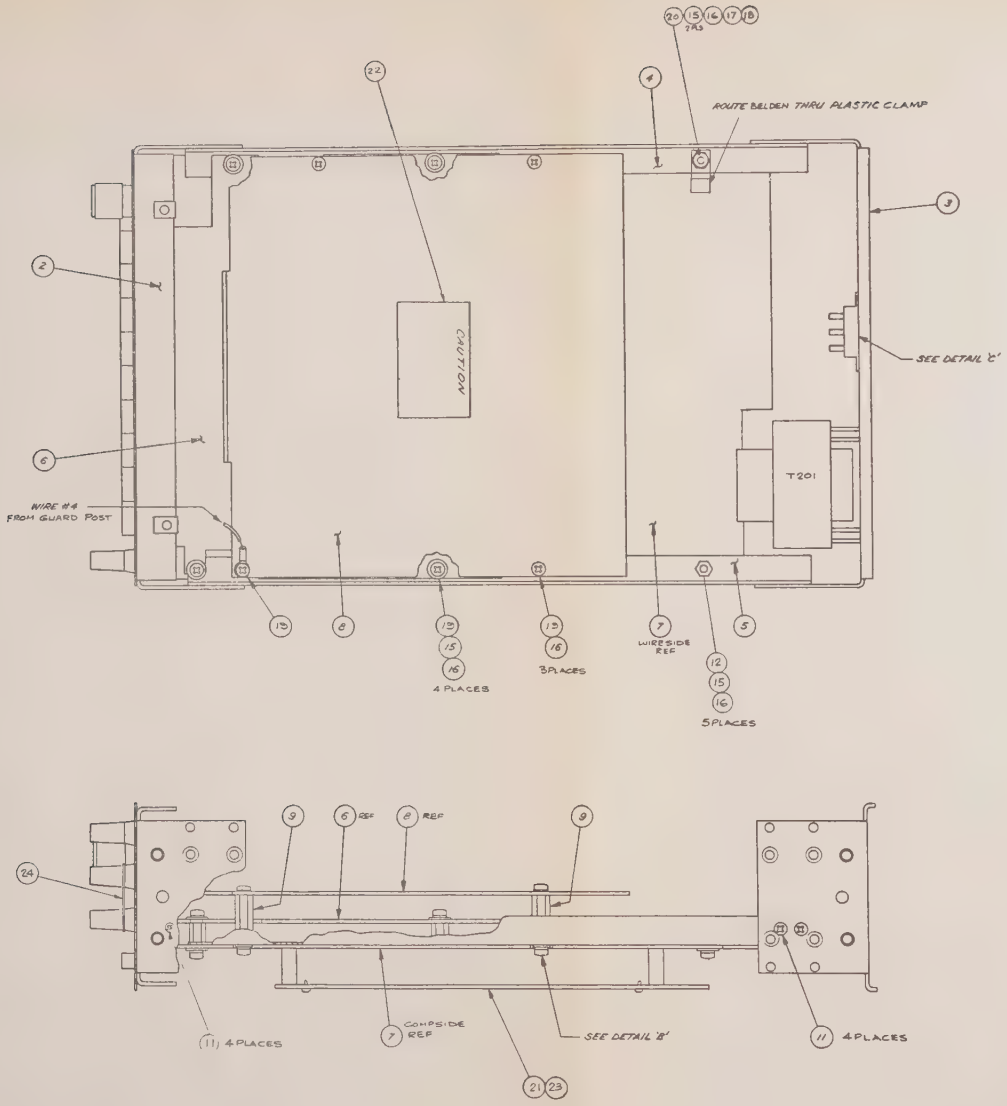
Code	Name	Address
91637	Dale Electronics Inc.	P.O. Box 609, Columbus, Ne. 68601
91967	National Tel Tronics Corp.	52 St. Casimer Ave., Yonkers, N.Y. 10701
98376	Zero Mfg. Co., West Division	1121 Chestnut St., Burbank, Ca. 91503
98978	International Electronic Research Corp.	135 West Magnolia Ave., Burbank, Ca. 91502
99392	S T M	2904 Chapman St., Oakland, Ca. 94601
99515	Marshall Industries Capacitor Div.	1960 Walker Ave., Monrovia, Ca. 91016
99942	Centralab Semiconductor Centralab Electronics Div. of Globe-Union Inc.	4501 N. Arden Dr., El Monte, Ca. 91734

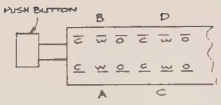


MODEL 7004A, BLOCK DIAGRAM
SCHEMATIC #037190-7-1 REV D

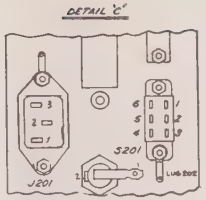


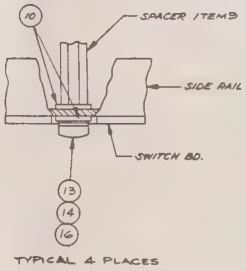
FINAL ASSEMBLY
#037190-4-1 REV C



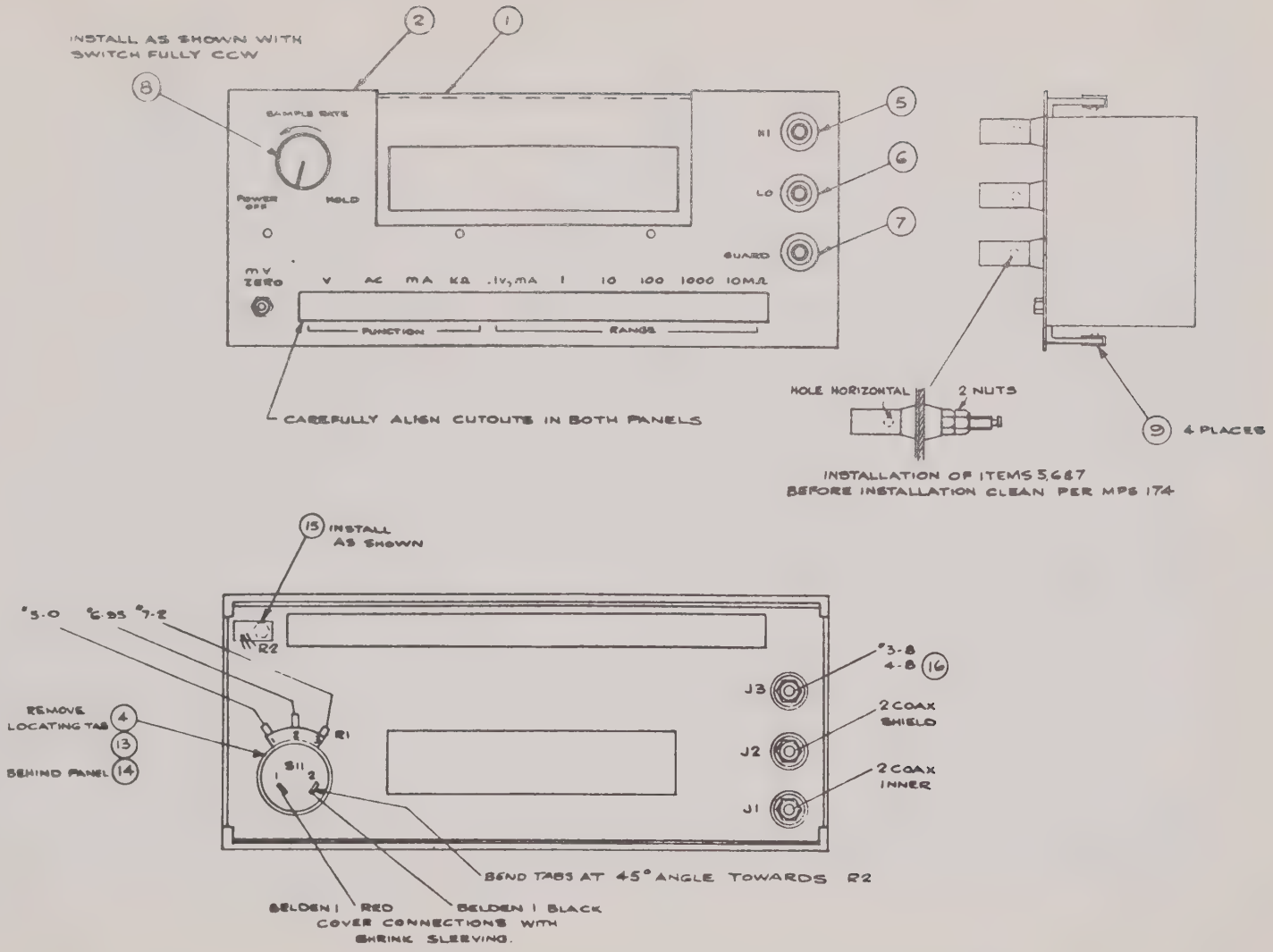


SWITCH DETAIL
TYPICAL
C = CLOSED
W = WIPER
O = OPEN





TEST ASSEMBLY
#037197-4-1 REV H



FRONT PANEL ASSEMBLY #037198-4-1 REV C

REPLACEABLE PARTS LIST

Equipment/Assembly Designation: FINAL ASSEMBLY #037190-4-1

(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
ITEM	REF					
1		ASSEMBLY, FINAL, 7004A	06811	037190-4-1		037190-4-1
2		SET, FEET	21604	PP40012&40013	1	H2037
3		NUT: Speed 6-32	78553	C7494-632-4	6	H2062
4		SCREW, PAN HEAD MACHINE: 6-32 X 1/2	MIL	MS51957-30	6	H0283
5		ASSEMBLY, TEST	06811	037197-4-1	1	037197-4-1
6		BAIL, SHORT	15933	32000-716	1	H2035
7		ASSEMBLY, BOTTOM COVER	06811	045065-3	1	045065-3
8		COVER, BOTTOM	06811	045013-3	1	045013-3
9		TRIM, END	06811	039033	4	039033
11		TRIM, SIDE	06811	039859-3	2	039859-3
13		HANDLE	06811	033570-3	2	033570-3
15		TRIM, FRONT	06811	037230-6-1	2	037230-6-1
19		TRIM, STRIP	06811	037203-1-1	1	037203-1-1
21		LABEL, TRIM STRIP	06811	037719	1	037719
23		PLATE, NAME	06811	023456	1	023456
25		CORD, LINE	70903	BR-1736	1	W0095
26		BRACKET, MOUNTING COVER	06811	039857	2	039857
27		COVER, TOP	06811	033567-3	1	033567-3
29		NUT: Tinnerman 6-32	78553	C880-632-24	4	H1907
30		SCREW, FLAT HEAD MACHINE: 8-32 X 5/8, 100°	MIL	MS24693-C51	8	H1733

REPLACEABLE PARTS LIST

Equipment/Assembly Designation FINAL ASSEMBLY #037190-4-1 (Cont'd)

(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
ITEM	REF					
31		SCREW, PAN HEAD MACHINE: 6-32 X 5/16	MIL	MS51957-27	6	H1281
32		SCREW, FLAT HEAD MACHINE: 6-32 X 1/4, 100°	MIL	MS24693-C24	4	H0430
33		SCREW, FLAT HEAD MACHINE: 2-56 X 1/4, 100°	MIL	AN507-C256-R4	3	H1156
34		WASHER: Split-lock #6	MIL	MS35338-136	4	H0783
35		CORD: Vinyl tubing	23172	PVC-105/16-2	A/R	H1902
36		SCREW, FLAT HEAD MACHINE: 6-32 X 5/16, 100°	MIL	MS24693-C25	2	H0287

REPLACEABLE PARTS LIST

Equipment/Assembly Designation: TEST ASSEMBLY #037197-4-1

(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
ITEM	REF					
2		ASSEMBLY, FRONT PANEL	06811	037198-4-1	1	037198-4-1
3		ASSEMBLY, REAR PANEL	06811	037747	1	037747
4		RAIL, SIDE: Left hand	06811	037207-1-1	1	037207-1-1
5		RAIL, SIDE: Right hand	06811	037209-1-1	1	037209-1-1
6		P.C. BOARD: Readout	06811	037215-4-1	1	037215-4-1
7		ASSEMBLY, SWITCH BOARD & CABLE	06811	037464-1-1	1	037464-4-1
8		COVER, GUARD TOP	06811	037210-1-1	1	037210-1-1
9		SPACER: 6-32 X 3/4	06540	8218-B-0632-3A	4	H0612
10		WASHER: Shoulder #6	83330	2153	8	H1155
11		SCREW, FLAT HEAD MACHINE: 4-40 X 3/16	MIL	MS24693-C1	8	H1798
12		SCREW, PAN HEAD MACHINE 6-32 X 5/16	MIL	MS51957-27	5	H1281
13		SCREW, PAN HEAD MACHINE 6-32 X 7/16	MIL	MS51957-29	4	H1697
14		WASHER: Small, flat #6	86928	5710-23-10	4	H0484
15		WASHER: Flat #6	MIL	MS15795-805	11	H0759
16		WASHER: Split-lock #6	MIL	MS35338-136	13	H0783
17		CABLE, CLAMP	MIL	37021710	1	H0788
18		NUT: Hex 6-32	MIL	NAS671C6	1	H0380
19		SCREW, PAN HEAD MACHINE: 6-32 X 1/4	MIL	MS51957-26	8	H0986

REPLACEABLE PARTS LIST

Equipment/Assembly Designation: TEST ASSEMBLY #037197-4-1 (Cont'd)

(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
ITEM	REF					
20		SCREW, PAN HEAD MACHINE: 6-32 X 1/2	MIL	MS51957-30	1	H0283
21		ASSEMBLY, GUARD, BOTTOM COVER	06811	037214-4-1	1	037214-4-1
22		LABEL, CAUTION	06811	037471-6-1	1	037471-6-1
23		SCREW, FLAT HEAD MACHINE: 6-32 X 5/16	MIL	MS24693-C25	4	H0287
24		STRAP, SHORTING LINK	24655	0938-9503	1	E0317
		ASSEMBLY, SWITCH	06811	037217-4-1	1	037217-4-1
	J102	ASSEMBLY, CABLE	06811	037465-3-1	1	037465-3-1
		TIE, CABLE: Nylon	06383	SSTIM	1	H1104
		CONNECTOR, P.C.: 15-position, dual	05574	2VH15/1AN5	1	J0504
		BUMPER: Nylon	11897	138-NN-5324	4	H2068

REPLACEABLE PARTS LIST

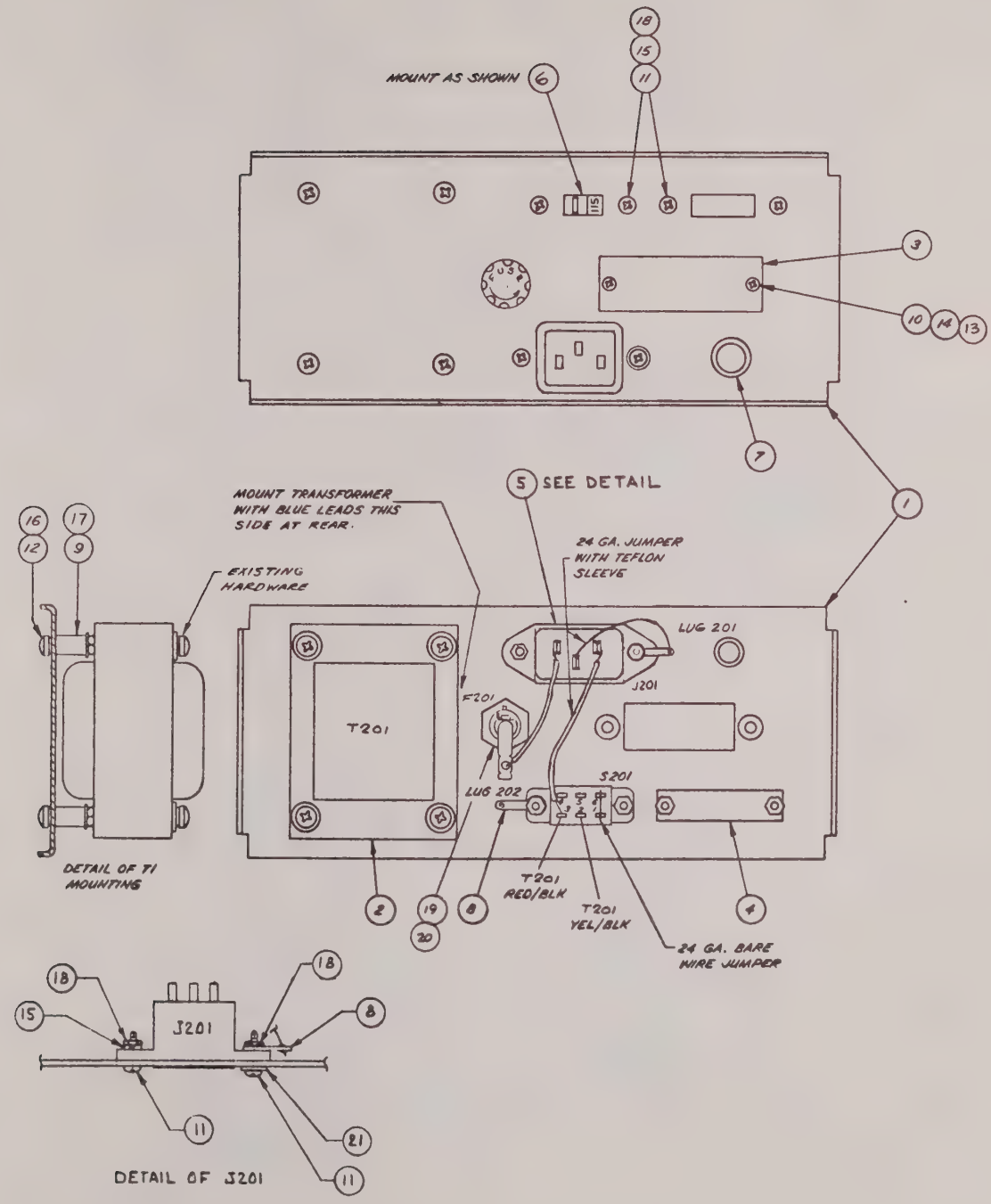
Equipment/Assembly Designation: FINAL ASSEMBLY #037190-4-1

(1) Reference Designation ITEM	REF	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
1		ASSEMBLY, FINAL, 7004A	06811	037190-4-1		037190-4-1
2		SET, FEET	21604	PP40012&40013	1	H2037
3		NUT: Speed 6-32	78553	C7494-632-4	6	H2062
4		SCREW, PAN HEAD MACHINE: 6-32 X 1/2	MIL	MS51957-30	6	H0283
5		ASSEMBLY, TEST	06811	037197-4-1	1	037197-4-1
6		BAIL, SHORT	15933	32000-716	1	H2035
7		ASSEMBLY, BOTTOM COVER	06811	045065-3	1	045065-3
8		COVER, BOTTOM	06811	045013-3	1	045013-3
9		TRIM, END	06811	039033	4	039033
11		TRIM, SIDE	06811	039859-3	2	039859-3
13		HANDLE	06811	033570-3	2	033570-3
15		TRIM, FRONT	06811	037230-6-1	2	037230-6-1
19		TRIM, STRIP	06811	037203-1-1	1	037203-1-1
21		LABEL, TRIM STRIP	06811	037719	1	037719
23		PLATE, NAME	06811	023456	1	023456
25		CORD, LINE	70903	BR-1736	1	W0095
26		BRACKET, MOUNTING COVER	06811	039857	2	039857
27		COVER, TOP	06811	033567-3	1	033567-3
29		NUT: Tinnerman 6-32	78553	C880-632-24	4	H1907
30		SCREW, FLAT HEAD MACHINE: 8-32 X 5/8, 100°	MIL	MS24693-C51	8	H1733

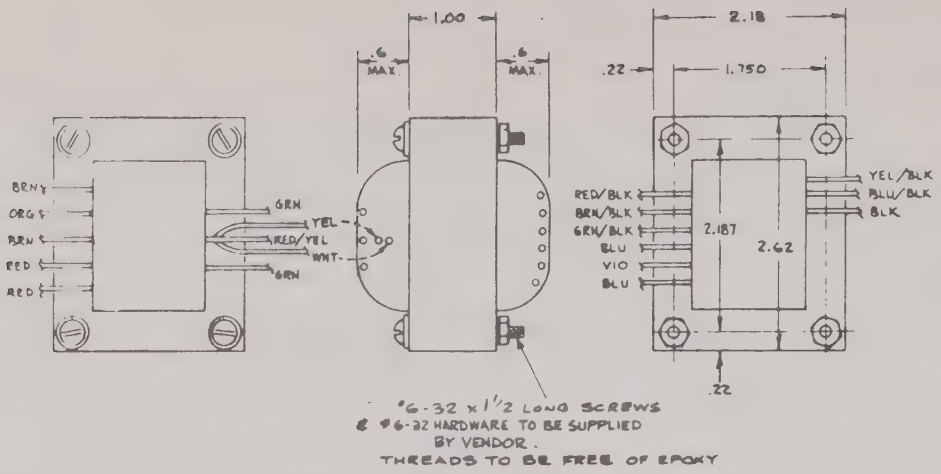
REPLACEABLE PARTS LIST

Equipment/Assembly Designation FINAL ASSEMBLY #037190-4-1 (Cont'd)

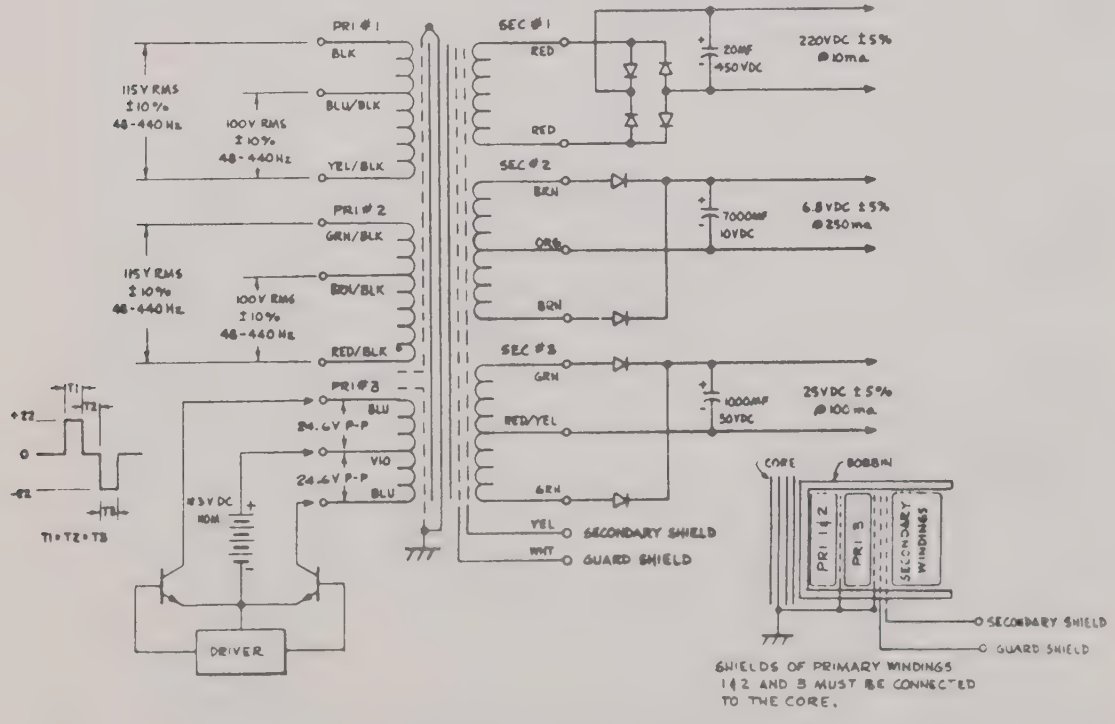
(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
ITEM	REF					
31		SCREW, PAN HEAD MACHINE: 6-32 X 5/16	MIL	MS51957-27	6	H1281
32		SCREW, FLAT HEAD MACHINE: 6-32 X 1/4, 100°	MIL	MS24693-C24	4	H0430
33		SCREW, FLAT HEAD MACHINE: 2-56 X 1/4, 100°	MIL	AN507-C256-R4	3	H1156
34		WASHER: Split-lock #6	MIL	MS35338-136	4	H0783
35		CORD: Vinyl tubing	23172	PVC-105/16-2	A/R	H1902
36		SCREW, FLAT HEAD MACHINE: 6-32 X 5/16, 100°	MIL	MS24693-C25	2	H0287



REAR PANEL ASSEMBLY #037747 REV A



1. PRIMARY WINDINGS CONNECT IN PARALLEL FOR 115V RMS OR 100V RMS OPERATION.
2. PRIMARY WINDINGS CONNECT IN SERIES FOR 230V RMS OR 200V RMS OPERATION.
3. DC OUTPUT VOLTAGE TOLERANCE SPECIFIED WITH 115VRMS 48-440 Hz LINE, OR 44V PEAK TO PEAK RECTANGULAR DRIVE.
4. MAXIMUM ALLOWABLE TEMPERATURE RISE IS 40°C.
5. OPERATING AMBIENT TEMPERATURE RANGE IS 0 TO +65°C.
6. ALL LEAD LENGTHS - 12 INCHES MINIMUM. TEFLON INSULATED AND COLOR CODED AS SHOWN.
7. SECONDARY WINDINGS TO SHIELDS, OR SHIELD TO SHIELD BREAKDOWN VOLTAGE SHALL EXCEED 1KV RMS, 60Hz.
8. VACUUM IMPREGNATE WITH EPOXY.
9. ALL RECTIFIERS SHOWN ARE IN4006 (1 AMP SILICON).
10. ALL LEADS WILL BE BROUGHT OUT AS SHOWN.
11. TRANSFORMER TO BE MARKED WITH "SD 37470-6-1, REV _" (LATEST REV.).



SPECIFICATION TRANSFORMER #037470-6-1 REV A

REPLACEABLE PARTS LIST

Equipment/Assembly Designation: FRONT PANEL ASSEMBLY #037198-4-1

(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
ITEM	REF					
1		PANEL, FRONT	06811	037199-1-1	1	037199-1-1
2		PANEL, FRONT DECORATIVE	06811	037201-6-1	1	037201-6-1
4	R1/S11	RESISTOR, POTENTIOMETER, CERAMIC: 100 kΩ, with switch, single pull, single throw, CCW, with indent position switch CW	06811	CTS GC-45	1	R2823
5	J1	BINDING POST: Red	32767	820-65	1	102803
6	J2	BINDING POST: Black	32767	820-45	1	102802
7	J3	BINDING POST: White	32767	820-25	1	102801
8		KNOB	86797	RB-67-1-DC-M-L	1	H1937
9		NUT: U type, 6-32	06811	H1692	4	H1692
13		NUT: Hex 3/8-32	83330	11956	1	H0466
14		WASHER: 3/8, int. tooth	78189	1220-02CAD	1	H0507
15	R2	RESISTOR, POTENTIOMETER, CERAMIC: 200 Ω ±10%, 3/4 W, 22-turn, panel mount	73138	78LBWR200	1	R2828
16		LUG: Solder #6	73734	1955	1	E0118

REPLACEABLE PARTS LIST

Equipment/Assembly Designation: REAR PANEL ASSEMBLY #037747

(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
ITEM	REF					
1		PANEL, REAR	06811	037746	1	037746
2	T201	TRANSFORMER, POWER	06811	037470-6-1	1	037470-6-1
3		PLATE, COVER: 24 pin connector	06811	031418-1-1	1	031418-1-1
4		PLATE, COVER	06811	031399-1-1	1	031399-1-1
5	J202	CONNECTOR, POWER: Male chassis receptacle	82389	EAC-301	1	J0664
6	S201	SWITCH, SLIDE	82389	46206LFR	1	S0384
7		GROMMET: 3/8 diameter	28520	SB-375-4	1	H1244
8	LUG 201	LUG: Solder 4-40	79963	9-.120	2	H0539
9	LUG 202	LUG: Solder 4-40	79963	9-.120	2	H0539
10		SCREW, PAN HEAD MACHINE 2-56 X 5/16	MIL	MS51957-4	2	H1275
11		SCREW, PAN HEAD MACHINE: 4-40 X 3/8	MIL	MS51957-15	6	H0376
12		SCREW, PAN HEAD MACHINE: 6-32 X 1/4	MIL	MS51957-26	4	H0986
13		WASHER: Flat #2	MIL	MS15795-802	1	H0138
14		WASHER: Split-lock #2	MIL	MS35337-77	1	H0481
15		WASHER: Split-lock #4	MIL	MS35338-135	5	H0782
16		WASHER: Split-lock #6	MIL	MS35338-136	4	H0783
17		WASHER: Flat #6	MIL	MS15795-805	4	H0759
18		NUT: Hex 4-40	MIL	NAS671C4	6	H0249
19		POST, FUSE: For 3AG	75915	342004	1	X0034

REPLACEABLE PARTS LIST

Equipment/Assembly Designation REAR PANEL ASSEMBLY #037747 (Cont'd)

(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
ITEM	REF					
20	F201	FUSE: .300 A, 250 V	75915	323.300	1	F0077
21		WASHER: Int. tooth #4	MIL	MS35333-70	1	H1282

CIRCUIT DESCRIPTION
A1, COUNT CHAIN AND READOUT
SCHEMATIC #037215-7-1

This assembly contains the timing and control logic, the polarity and off-scale indicators, and the digital count chain and readout. Generally, the operations on this board will be described in sequence unless otherwise noted.

At the beginning of a new integrating cycle, ∫ex, the unknown voltage, ex, from the main amplifier, A2U1, is coupled through FET switch, A2Q15, which is held on by a low level on the $\overline{\int ex}$ line. At the same time a high on the $\overline{\int ec}$ line turns off the FET switch A2Q12 and removes the short across the integrating capacitor A2C41.

The clock, A1U16, operating at 100 kHz, produces a chain of pulses from pin 8 which is counted by decades, A1U10-U13 on pin 14. The clock output is gated through NAND gates A1U20, pins 3 & 6. After 10,000 pulses have been counted during ∫ex, dual J-K, A1U5, produces two outputs. Pins 7 & 12 go high and 10 & 13 go low. Three functions occur: the clock is inhibited for 16 counts, integration of the unknown voltage, ∫ex, is stopped, and integration of the proper reference +∫er or -∫er is started.

To stop the clock for 16 counts, the A1U5 J-K output from pins 7 & 12 turns on Q6. This presents a high on the NAND gate, A1U21 pin 2 where pin 3 is already high. This turns on the four-bit binary counter A1U21 which is wired for ÷16 counting. Decoder A1U22 keeps the output of A1U20 pin 8 low for 16 counts which stops the clock through the gate A1U20 pin 6 and inverter A1U22 pin 8.

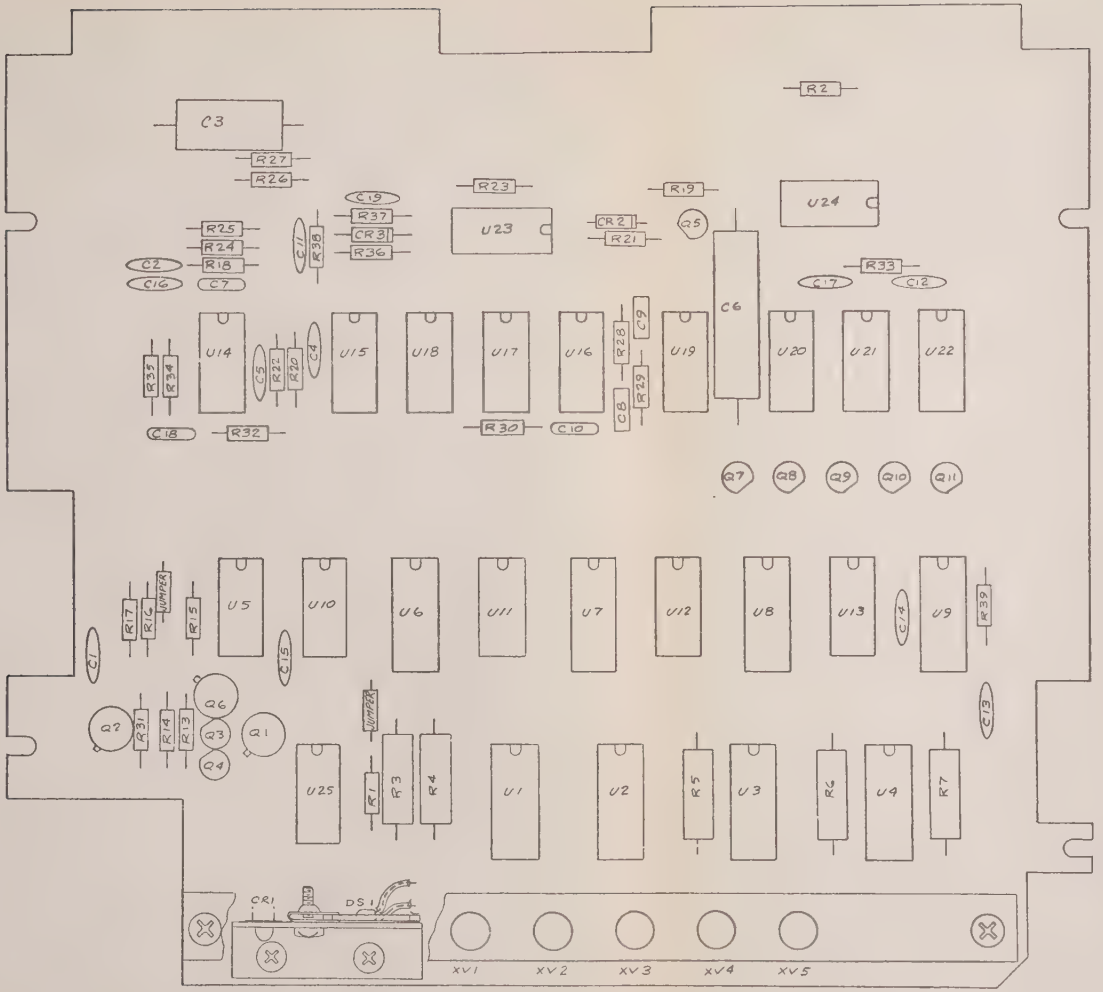
Integration of the unknown voltage is stopped by the output of A1U5 pins 10 & 13 which toggles flip-flop A1U19 with a low on pin 5. The ∫ex line flips high and opens the FET switch A2Q15 shutting off the integration of the unknown voltage, ex.

Integration of the proper reference is started by the high output of flip-flop A1U19 pin 6 setting all the following NAND gate lines high: A1U16 pins 4 & 2 and A1U18 pins 9 & 12. During ∫ex the output of the zero detector A2U7 has either been high (negative ex) or low (positive ex). The output, X_0, from A2U7 (terminal 13) is fed to the A1U24 inverter. This high or low level is fed to A1U16 via inverter A1U15, pin 11, so that opposite levels appear at pins 1 & 5 of A1U16. For a negative ex, pin 5 of A1U16 is high, w/pin 1 low, and pin 5 of flip-flop A1U18 is low; thus making pin 13 high and pin 11 low. With the +∫er line low, the +REF is coupled through FET switch A2Q13 to the integrator and positive integration +∫er, of the + reference begins. This integration is in the opposite direction to the unknown integration. Similarly for a positive ex, the -∫er line is low and the -REF is coupled through FET switch A2Q14 for negative integration, -∫er, of the - reference. The minus indicator

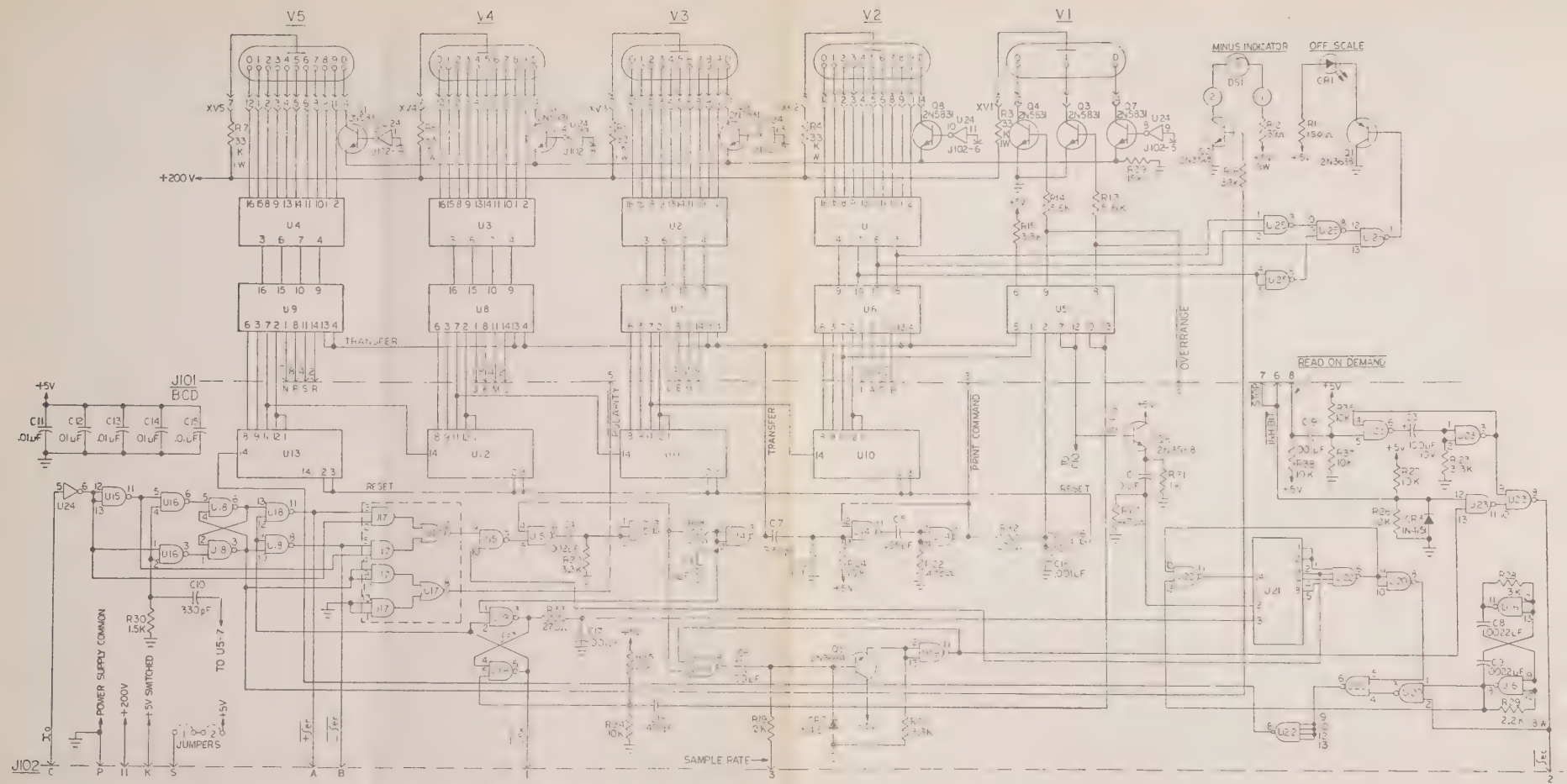
is turned on for a low on pin 3 of A1U18 with positive polarity not shown.

The output of A1U17, at this time, presents the polarity on pin 5 of the BCD connector J101 and presents a low on the input pin 9 of NAND gate A1U15. Since pin 10 of NAND gate A1U15 is high, nothing happens. However, when the zero detector detects that the ∫er has integrated back to zero, the X_o line changes polarity, switching the state of A1U24. This change of state, via A1U15 and A1U16, flips A1U18 which drives the output of A1U17 pin 6 and input of A1U15 pin 9 high. This high on pin 9 and the high already on pin 10 of A1U15 produces a low output, triggering the delay one-shot pins 6 & 3 of A1U15. This one-shot pulse does two things: the one-shot turns on the 5 ms clamp pins 8 & 11 of A1U19 which shuts the clock off, and this low on the $\overline{\int ec}$ line turns on FET switch A2Q12 and shorts the integrating capacitor A2C41.

Also, the delay one-shot A1U15 places a low on pin 1 of A1U14 which produces a high on the TRANSFER line and transfers the count from decades A1U10-U13 to buffer storages A1U5-U9. The OFF SCALE indicator lights when A1U25 decodes a count of 13000. The cycle is ready to begin again.



A1, COUNT CHAIN AND READOUT
ASSEMBLY #037215-4-1 REV E



NOTE:
1. ALL RESISTORS 1/4 W UNLESS OTHERWISE SPECIFIED.

U	TYPE
1,2,3,4	SN7441AN
6,7,8,9	SN74L*91N
10,11,12,13	SN74L90N
14	SN74L91N
2	SN7493N
22	SN74L20N

A1, COUNT CHAIN AND READOUT
SCHEMATIC #037215-7-1 REV F

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A1, COUNT CHAIN AND READOUT #037215-4-1

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A1	P.C. BOARD: Count Chain-Readout	06811	037214-1-1	1	037214-1-1
A1C1	CAPACITOR, CERAMIC: .01 µF +80-20%, 100 Vdcw	91418	TA110	7	C0556
A1C2	CAPACITOR, CERAMIC: .01 µF +80-20%, 100 Vdcw	91418	TA110	7	C0556
A1C3	CAPACITOR, TANT: 100 µF ±20%, 10 Vdcw	56289	150D107X9010R2	1	C0660
A1C4	CAPACITOR, CERAMIC: 2000 pF ±10%, 1 kV	71590	DD-202	1	C0328
A1C5	CAPACITOR, CERAMIC: .05 µF +80-20%, 10 Vdcw	71590	UK10-503	1	C0672
A1C6	CAPACITOR, ELECTROLYTIC: 100 µF +75-10%, 25 Vdcw	56289	TE1211	1	C0832
A1C7	CAPACITOR, CERAMIC: 330 pF ±10%, 500 Vdcw	71590	CE-331	2	C0898
A1C8	CAPACITOR, CERAMIC: 2200 pF ±20%, 200 Vdcw	32159	RH06CX222M	2	C0687
A1C9	CAPACITOR, CERAMIC: 2200 pF ±20%, 200 Vdcw	32159	Rh06CX222M	2	C0687
A1C10	CAPACITOR, CERAMIC: 330 pF ±10%, 500 Vdcw	71590	CE-331	2	C0898
A1C11	CAPACITOR, CERAMIC: .01 µF +80-20%, 100 Vdcw	91418	TA110	7	C0556
A1C12	CAPACITOR, CERAMIC: .01 µF +80-20%, 100 Vdcw	91418	TA110	7	C0556

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A1, COUNT CHAIN AND READOUT #037215-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A1C13	CAPACITOR, CERAMIC: .01 µF +80-20%, 100 Vdcw	91418	TA110	7	C0556
A1C14	CAPACITOR, CERAMIC: .01 µF +80-20%, 100 Vdcw	91418	TA110	7	C0556
A1C15	CAPACITOR, CERAMIC: .01 µF +80-20%, 100 Vdcw	91418	TA110	7	C0556
A1C16	CAPACITOR, CERAMIC: 1000 pF ±20%, 1 kV	91418	Type B	3	C0424
A1C17	CAPACITOR, CERAMIC: 1000 pF ±20%, 1 kV	91418	Type B	3	C0424
A1C18	CAPACITOR, MICA: 470 pF ±5%, 500 Vdcw, crimp lead	72136	DM15FC471J0	1	C0542
A1C19	CAPACITOR, CERAMIC: 1000 pF ±20%, 1 kV	91418	Type B	3	C0424
A1CR1	DIODE, LIGHT EMITTING: .21 D, 50 mA	50579	RED-LIT 7	1	CR0367
A1CR2	SEMICONDUCTOR DEVICE, DIODE: Silicon, 50 Vdcw, 150 mA	03508	1N4151	2	CR0150
A1CR3	SEMICONDUCTOR DEVICE, DIODE: Silicon, 50 Vdcw, 150 mA	03508	1N4151	2	CR0150
A1DS1	LAMP, INCANDESCENT: 80 mA, 5 V, T-3/4, Wire lead	71744	CM-8666	1	I0050
A1Q1	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, PNP	07263	2N3638	1	Q0181

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A1, COUNT CHAIN AND READOUT #037215-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A1Q2	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3569	1	Q0318
A1Q3	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN, 160 V	07263	2N5831	7	26004021
A1Q4	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN, 160 V	07263	2N5831	7	26004021
A1Q5	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3694	1	26012660
A1Q6	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3568	1	Q0180
A1Q7	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN, 160 V	07263	2N5831	7	26004021
A1Q8	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN, 160 V	07263	2N5831	7	26004021
A1Q9	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN, 160 V	07263	2N5831	7	26004021
A1Q10	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN, 160 V	07263	2N5831	7	26004021
A1Q11	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN, 160 V	07263	2N5831	7	26004021

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A1, COUNT CHAIN AND READOUT #037215-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A1R1	RESISTOR, COMP: 150 Ω ±5%, 1/4 W	01121	CB1515	1	R0983
A1R2	RESISTOR, COMP: 39 Ω ±5%, 1/4 W	01121	CB3905	1	R1552
A1R3	RESISTOR, COMP: 33 kΩ ±5%, 1 W	01121	GB3335	5	R1263
A1R4	RESISTOR, COMP: 33 kΩ ±5%, 1 W	01121	GB3335	5	R1263
A1R5	RESISTOR, COMP: 33 kΩ ±5%, 1 W	01121	GB3335	5	R1263
A1R6	RESISTOR, COMP: 33 kΩ ±5%, 1 W	01121	GB3335	5	R1263
A1R7	RESISTOR, COMP: 33 kΩ ±5%, 1 W	01121	GB3335	5	R1263
A1R8	Not used				
A1R9	Not used				
A1R10	Not used				
A1R11	Not used				
A1R12	Not used				
A1R13	RESISTOR, COMP: 5.6 kΩ ±5%, 1/4 W	01121	CB5625	2	R0821
A1R14	RESISTOR, COMP: 5.6 kΩ ±5%, 1/4 W	01121	CB5625	2	R0821
A1R15	RESISTOR, COMP: 3.3 kΩ ±5%, 1/4 W	01121	CB3325	5	R0742

REPLACEABLE PARTS LIST

Equipment/Assembly Designation: A1, COUNT CHAIN AND READOUT #037215-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A1R16	RESISTOR, COMP: 3.3 kΩ ±5%, 1/4 W	01121	CB3325	5	R0742
A1R17	RESISTOR, COMP: 470 Ω ±5%, 1/4 W	01121	CB4715	2	R1044
A1R18	RESISTOR, COMP: 220 Ω ±5%, 1/4 W	01121	CB2215	1	R0760
A1R19	RESISTOR, COMP: 2.0 kΩ ±5%, 1/4 W	01121	CB2025	1	R0734
A1R20	RESISTOR, COMP: 3.3 kΩ ±5%, 1/4 W	01121	CB3325	5	R0742
A1R21	RESISTOR, COMP: 3.3 kΩ ±5%, 1/4 W	01121	CB3325	5	R0742
A1R22	RESISTOR, COMP: 470 Ω ±5%, 1/4 W	01121	CB4715	2	R1044
A1R23	RESISTOR, COMP: 3.3 kΩ ±5%, 1/4 W	01121	CB3325	5	R0742
A1R24	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	9	R0766
A1R25	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	9	R0766
A1R26	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	9	R0766
A1R27	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	9	R0766
A1R28	RESISTOR, COMP: 3.0 kΩ ±5%, 1/4 W	01121	CB3025	2	R0711

REPLACEABLE PARTS LIST

Equipment/Assembly Designation: A1, COUNT CHAIN AND READOUT #037215-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A1R29	RESISTOR, COMP:				
A1R30	RESISTOR, COMP: 1.5 kΩ ±5%, 1/4 W	01121	CB1525	1	R0783
A1R31	RESISTOR, COMP: 1 kΩ ±5%, 1/4 W	01121	CB1025	1	R0765
A1R32	RESISTOR, COMP: 270 Ω ±5%, 1/4 W	01121	CB2715	2	R0694
A1R33	RESISTOR, COMP: 270 Ω ±5%, 1/4 W	01121	CB2715	2	R0694
A1R34	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	9	R0766
A1R35	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	9	R0766
A1R36	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	9	R0766
A1R37	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	9	R0766
A1R38	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	9	R0766
A1R39	RESISTOR, COMP: 15 kΩ ±5%, 1/4 W	01121	CB1535	1	R0728
A1U1	INTEGRATED CIRCUIT: BCD to decimal decoder/driver, TTL	01295	SN74141N	4	025730
A1U2	INTEGRATED CIRCUIT: BCD to decimal decoder/driver, TTL	01295	SN74141N	4	025730

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A1, COUNT CHAIN AND READOUT #037215-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A1U3	INTEGRATED CIRCUIT: BCD to decimal decoder/driver, TTL	01295	SN74141N	4	025730
A1U4	INTEGRATED CIRCUIT: BCD to decimal decoder/driver, TTL	01295	SN74141N	4	025730
A1U5	INTEGRATED CIRCUIT: Dual J-K flip-flop, TTL	01295	SN74L73N	1	045200
A1U6	INTEGRATED CIRCUIT: Quad latch, TTL	01295	SN74L75N	4	045201
A1U7	INTEGRATED CIRCUIT: Quad latch, TTL	01295	SN74L75N	4	045201
A1U8	INTEGRATED CIRCUIT: Quad latch, TTL	01295	SN74L75N	4	045201
A1U9	INTEGRATED CIRCUIT: Quad latch, TTL	01295	SN74L75N	4	045201
A1U10	INTEGRATED CIRCUIT: Decade counter, TTL	01295	SN74L90N	4	045202
A1U11	INTEGRATED CIRCUIT: Decade counter, TTL	01295	SN74L90N	4	045202
A1U12	INTEGRATED CIRCUIT: Decade counter, TTL	01295	SN74L90N	4	045202
A1U13	INTEGRATED CIRCUIT: Decade counter, TTL	01295	SN74L90N	4	045202
A1U14	INTEGRATED CIRCUIT: Quad 2-input, NAND gate, TTL	01295	SN7400N	1	019705
A1U15	INTEGRATED CIRCUIT: Quad 2-input, NAND gate, TTL	01295	SN74L00N	7	025796

Equipment/Assembly Designation A1, COUNT CHAIN AND READOUT #037215-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A1U16	INTEGRATED CIRCUIT: Quad 2-input, NAND gate, TTL	01295	SN74L00N	7	025796
A1U17	INTEGRATED CIRCUIT: Dual 2-input, 2-wide, AND-OR invert gates	01295	SN74L51N	1	025799
A1U18	INTEGRATED CIRCUIT: Quad 2-input, NAND gate, TTL	01295	SN74L00N	7	025796
A1U19	INTEGRATED CIRCUIT: Quad 2-input, NAND gate, TTL	01295	SN74L00N	7	025796
A1U20	INTEGRATED CIRCUIT: Quad 2-input, NAND gate, TTL	01295	SN74L00N	7	025796
A1U21	INTEGRATED CIRCUIT: 4-bit binary counter, TTL	01295	SN7493N	1	025715
A1U22	INTEGRATED CIRCUIT: Dual 4-input, NAND gate, TTL	01295	SN74L20N	1	025798
A1U23	INTEGRATED CIRCUIT: Quad 2-input, NAND gate, TTL	01295	SN74L00N	7	025796
A1U24	INTEGRATED CIRCUIT: Hex inverter	01295	SN74L04N	1	045204
A1U25	INTEGRATED CIRCUIT: Quad 2-input, NAND gate, TTL	01295	SN74L00N	7	025796
A1XU1	INTEGRATED CIRCUIT SOCKET: 8-terminal strip	27264	1938-4B-8	8	X0185
A1XU2	INTEGRATED CIRCUIT SOCKET: 8-terminal strip	27264	1938-4B-8	8	X0185
A1XU3	INTEGRATED CIRCUIT SOCKET: 8-terminal strip	27264	1938-4B-8	8	X0185

REPLACEABLE PARTS LIST

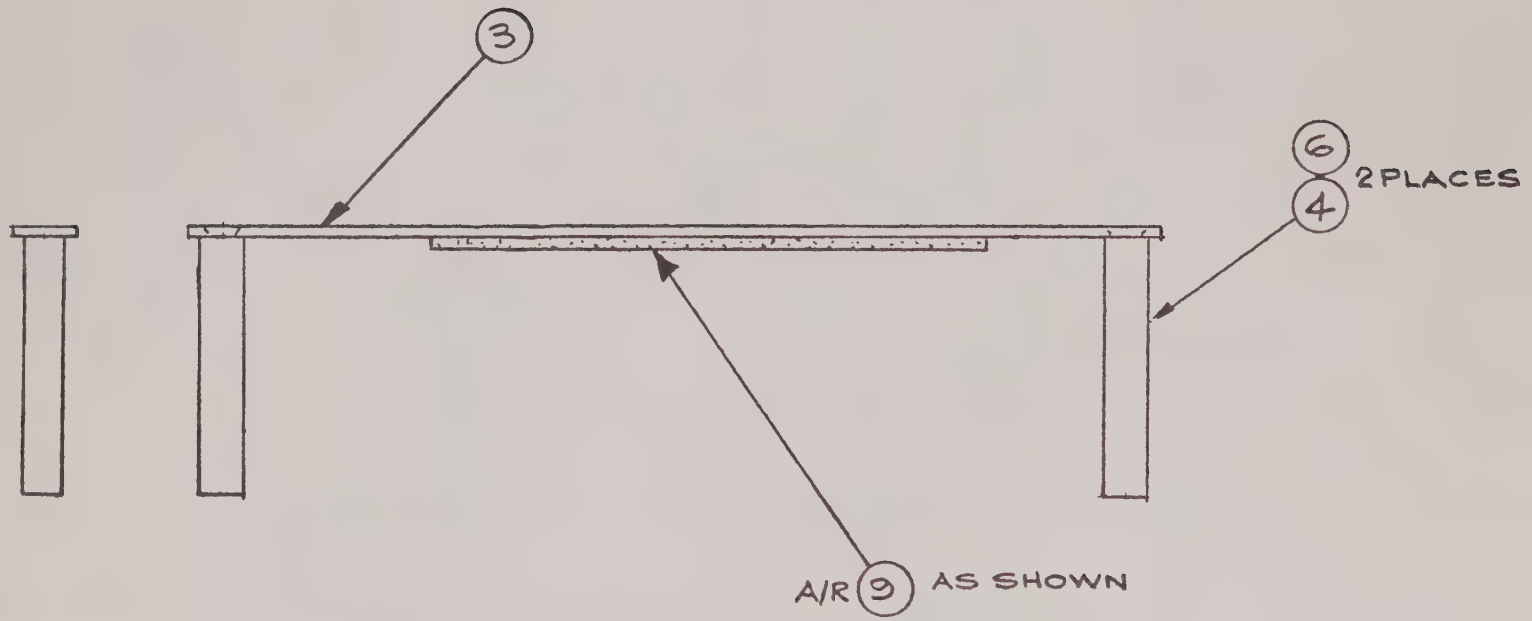
Equipment/Assembly Designation A1, COUNT CHAIN AND READOUT #037215-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A1XU4	INTEGRATED CIRCUIT SOCKET: 8-terminal strip	27264	1938-4B-8	8	X0185
A1XV1	DISPLAY NUMERALS: 0-9, 2-decimal point, .515 side	83781	NL-5750S	5	V0132
A1XV2	DISPLAY NUMERALS: 0-9, 2-decimal point, .515 side	83781	NL-5750S	5	V0132
A1XV3	DISPLAY NUMERALS: 0-9, 2-decimal point, .515 side	83781	NL-5750S	5	V0132
A1XV4	DISPLAY NUMERALS: 0-9, 2-decimal point, .515 side	83781	NL-5750S	5	V0132
A1XV5	DISPLAY NUMERALS: 0-9, 2-decimal point, .515 side	83781	NL-5750S	5	V0132
	ASSEMBLY, TUBE RETAINER	06811	037206-4-1	1	037206-4-1
	ASSEMBLY, MINUS BRACKET	06811	037235-4-1	1	037235-4-1
	BRACKET, RIGHT ANGLE	79963	176	2	H1689
	SCREW, PAN HEAD MACHINE: 6-32 X 5/16, black	08547	MV961-3323	2	60516000
	SCREW, PAN HEAD MACHINE: 6-32 X 5/16	MIL	MS51957-27	2	H1281
	SCREW, PAN HEAD MACHINE: 6-32 X 1/4	MIL	MS51957-26	2	H0986
	WASHER: Flat #6	MIL	MS15795-805	6	H0759
	WASHER: Split-lock #6	MIL	MS35338-136	6	H0783
	NUT: Hex 6-32	MIL	NAS671C6	2	H0380

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A1, COUNT CHAIN AND READOUT #037215-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
	PAD, TRANSISTOR	08289	501-000-D	3	H0515
	INSULATOR: 8-hole	06811	039466-3	8	039466-3

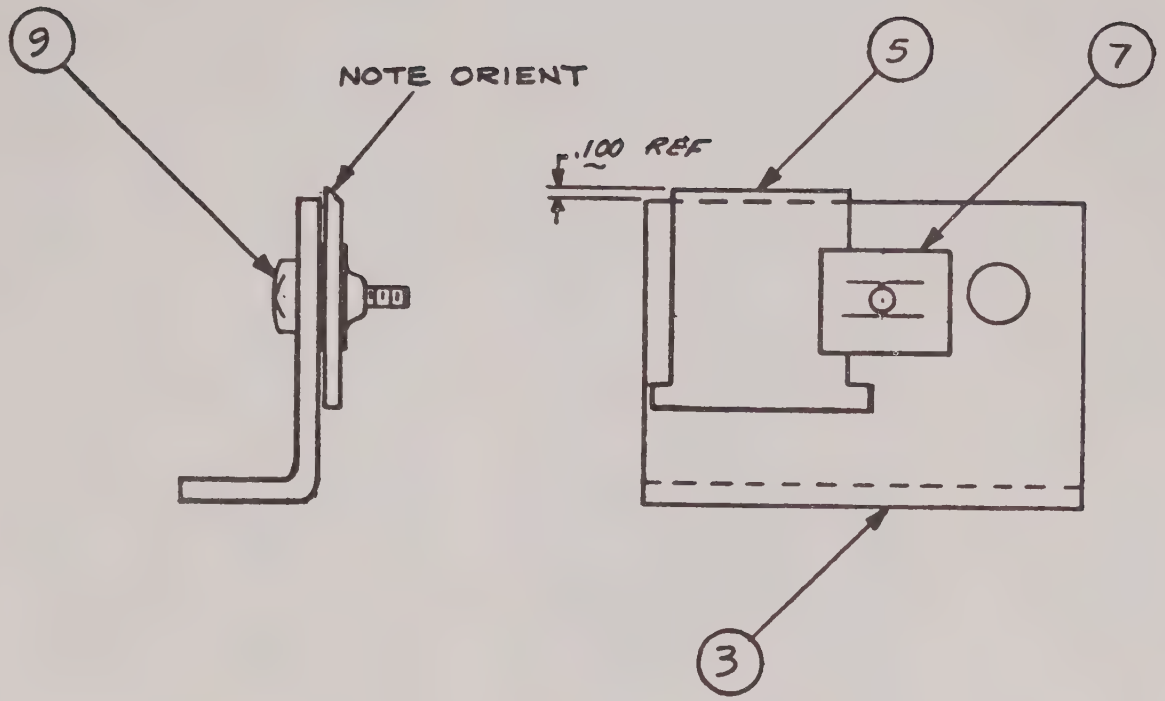


TUBE RETAINER ASSEMBLY #037206-4-1 REV A

REPLACEABLE PARTS LIST

Equipment/Assembly Designation: TUBE RETAINER #037206-4-1

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
	RETAINER, TUBE	06811	037206-1-1	1	037206-1-1
	SPACER, THREADED 6-32	83330	8349	2	H1878
	SCREW, FLAT HEAD MACHINE: 6-32 X 5/16	MIL	MS24693-C25	2	H0287
	TAPE: Foam, adhesive	76381	4308	3-1/4"	H1998



MINUS BRACKET ASSEMBLY #037235-4-1 REV B

REPLACEABLE PARTS LIST

Equipment/Assembly Designation: MINUS BRACKET #037235-4-1

(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks: SD Stock No.
ITEM	REF					
3		BRACKET, MINUS	06811	037235-1-1	1	037235-1-1
5		LIGHT-PIPE, MINUS	06811	48006791	1	48006791
7		NUT: Tinnerman #6	78553	C880-632-24	1	H1907
9		SCREW, PAN HEAD MACHINE: 6-32 X 5/16, black	08547	MV961-3323	1	60516000

CIRCUIT DESCRIPTION
A2, SWITCH BOARD
SCHEMATIC #037217-7-1

This assembly contains all of the analog electronics including the following circuits: DC Amplifier/DC current, AC-DC Converter/ AC Current, Ohms Circuit, A to D Converter, and Power Supply. Note: All switches are initially in the off position.

DC AMPLIFIER/DC CURRENT (Schematic 37217-7-1) Sheet 1 of 2)

The main dc amplifier consists of a switch-selected input attenuator, A2S9-C, A2S8-A-B-C, A2S7-B, A2S6-B, A2S9-A-B, and A2R8 through A2R16, followed by a passive filter, A2R17, A2R18, A2C5, A2C6, and a FET input, A2Q1, operational amplifier, A2U1. This amplifier has unity gain in the 10, 100, and 1000 ranges, a gain of 10 in the 1 range, and a gain of 100 in the .1 range. The input is developed across A2R35, A 10 kΩ resistor, with 10 volts full scale capability. To increase the good common mode characteristics of A2Q1, a transistorized current source, A2Q25 with a reference voltage generated by A2Q30 and A2VR17 is utilized. The offset of the amplifier is adjusted by the DC OFFSET potentiometer, A2R27 and the T.C. temperature compensation is controlled by A2R25. A mV ZERO potentiometer, A2R2, is in series with A2R25 for finer adjustment. Protection on all ranges is provided by clamping diodes A2VR1 and A2VR2.

DC current measurement is selected by the mA pushbutton A2S3-B. This switch selects a string of current shunt resistors, A2R2 through A2R5 with ranges .1 mA, 1 mA, 10 mA, 100 mA, and 1000 mA. The .1 mA and 1 mA range use the same shunt string A2R2, A2R3, A2R4, and A2R5 (1 kΩ) with a change in the gain of the amplifier via A2S5-B for a .1 mA and A2S6-A for 1 mA. The voltage drop across the shunt is then measured as in DC volts.

AC TO DC CONVERTER (Schematic 37217-7-1 , Sheet 1 of 2)

The AC to DC Converter consists of a frequency compensated input attenuator, a wide band precision rectifier, and a full wave averager with a differential dc amplifier.

The frequency compensated input attenuator divides the ac input voltage by factors of 10, 100, or 1000 in the 10, 100, and 1000 volt ranges. No attenuation occurs in the .1 and 1 volt ranges. The switch selected precision voltage divider consists of resistors A2R107, A2R108, and A2R109 which are initially ratio matched to A2R110 within ±.05%. Each attenuator range is frequency compen-

sated with fixed and adjustable trimmer capacitors. Trimmers, A2C49, A2C48, and A2C47 allow adjustment of the 10, 100, and 1000 ranges to compensate for capacitor tolerances and variation of stray capacitances. In the .1 and 1 ranges, 1 MΩ resistors A2R119 or A2R120 provide a dc return path to common for the noninverting input gate of the dual FET precision rectifier-amplifier, A2Q10.

The wide-band precision rectifier converts the ac input waveform into two pulsating dc components consisting of a positive half cycle and a negative half cycle. This rectifier circuit consists mainly of a dual FET differential amplifier, A2Q10 followed by a dual PNP transistor differential amplifier. This amplifier has high input impedance, high gain bandwidth product, and very low dc drift. Output transistors A2Q7 and A2Q8 provide low output impedance and rectification for the positive and negative signal components. The positive component is fed back to the inverting input of dual FET, A2Q10 via the frequency compensated feedback divider, A2R68, A2R70, and associated capacitors. Similarly, the negative component is fed back to the inverting input of dual FET, A2Q10 via the frequency compensated feedback divider, consisting of A2R69 and A2R70. Trimmer capacitor A2C32 adjusts the output vs frequency characteristic of the precision rectifier section, and should be adjusted for a flat characteristic on the .1 range. this one setting will also be adequate for the 1 range and should be set before the attenuator compensation adjustments are made. Due to the extremely high feedback factor of the precision rectifier amplifier, its gain is essentially independent of the active components and is mainly determined by the feedback divider resistor ratios. Over-voltage protection is provided by Zener diodes A2VR10, A2VR8, A2VR6, and A2VR7.

The full wave averager and differential dc amplifier averages, amplifies, and filters the precision rectified positive and negative signal components. The ac scale factor settings are made by adjusting the dc gain of the amplifier, A2Q1 & A2U1. Since this amplifier is operated in a differential input mode, the dc output is a function of the absolute value of the positive and negative input dc components. Since the fundamental ac components of the two inputs are equal in amplitude and in phase, cancellation of the fundamental ac components and in-phase harmonics occurs in the amplifier. The positive half cycles are fed to the positive noninverting input of the amplifier and the negative half cycles are fed to the inverting input of the amplifier. Some gain is provided by A2R58 and A2R59 with feedback A2R57. Out of phase harmonics and noise are reduced by the RC filter sections, A2C31, A2R70, A269, A2C38, A2R68, A2C30, A2R67, and A2C25. This type of full wave averaging allows fast converter response since ripple reduction at low frequencies is achieved with relatively short RC filter time constants. The switched 5 volt supply is turned off, inhibiting the polarity indicator.

To measure ac current, the same set of precision current shunt resistors used in the dc current mode are utilized. This resistor string is switched across the input terminals to obtain full scale current readings from 0.1 mA to 1000 mA in decade steps. Since the voltage developed across the shunt resistor is directly proportional to the current through it, measurement of this voltage drop produces a readout in ac mA. The full scale voltage drop across the shunt resistors is 100 mV for the 0.1 mA range, and 1 V for all other ranges. Fuse A2F1 limits the current to 1.5 amps.

OHMS CIRCUIT (Schematic 37217-7-1 , Sheet 1 of 2)

The Ohms Circuit utilizes the main dc amplifier, A2U1 & A2Q1 and dc attenuator network with the -REF as the current source. The main amplifier is clamped by A2VR4 so that the open circuit voltage does not exceed ±13 volts.

The -REF, through a set of resistors A2R8 through R16, depending on the range selected, provides a select constant current to the summing junction of the dc amplifier. The unknown resistor, connected across the HI and LO input terminals, acts as the feedback resistor for the summing amplifier. Note since the -REF supply is used, the HI terminal is negative with respect to the LO terminals. When measuring forward resistance of diodes, the anode should be connected to the LO terminal. The switched +5 V supply, +5 V SW, is turned off, inhibiting the polarity indicator.

ANALOG TO DIGITAL CONVERTER (Schematic 37217-7-1, Sheet 2 of 2)

This description includes the ± reference supplies, the integrator, and the zero detector.

The positive reference utilizes a 6.2 V precision Zener, A2VR5, and an operational amplifier A2U2. The output of +REF amplifier is +10 V dc adjusted by A2CR50. Additional jumpers may be utilized for A2R53 and A2R54 if the amplifier gain is not sufficient to deliver the full scale output voltage.

The negative reference, -REF, is generated by inverting the positive reference, +REF output. A unity gain, operational amplifier A2U3 is used as the inverter. Gain is adjustable with A2R36. The -REF is attenuated in the KΩ mode by a factor of one-half by switching R101. In this mode of operation, ±130 V can be applied to the instrument without damage. Since this -REF is connected across the output terminal, a voltage protection network consisting of A2Q26, A2CR18, and A2C17 is provided. A fuse is also provided for the 1 kΩ range which will blow at about 35 V.

The integrator consists of a FET input operational amplifier A2Q5 and A2U6. A clamp is provided across the integrating capacitor, A2C41, between each measurement cycle. The measurement cycle can be varied by the front panel SAMPLE RATE control. The input of the integrator is offset by A2R83 to correct for 16 counts delay which is provided at the end of the first measurement cycle. The clock is inhibited for 16 counts after the Full Scale pulse arrives.

The output of the integrator is fed into a voltage comparator A2U7. A2CR9 and A2CR10 at the input of the comparator are provided so the input is clamped to ± the diode drop. This improves the response of the comparator at zero crossover. The threshold (ZERO DET.) is adjustable through A2R71.

POWER SUPPLY (Schematic 37217-7-1, Sheet 2 of 2)

+5 V Supply

The regulated +5 V supply consists of NPN power transistor A2Q28, 5.4 volt reference Zener A2VR3, and associated components. The circuit is a basic emitter follower type series regulator. The output voltage is determined by the Zener reference voltage of A2VR3. A2VR3 is initially selected for a tolerance of ±.1 volt which eliminates the necessity for adjustment of the supply.

+17 V Supply

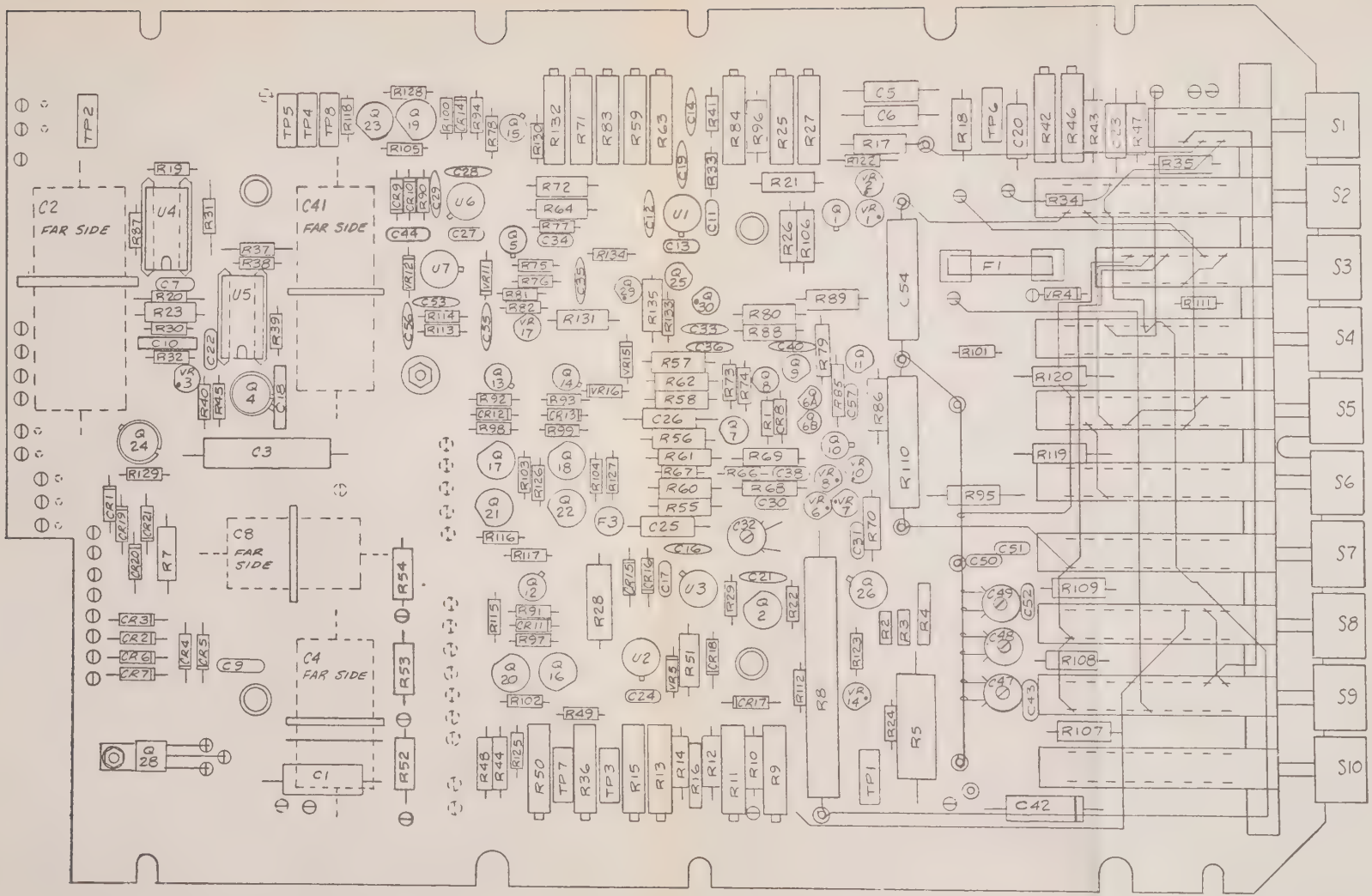
This supply uses an integrated circuit regulator, A2U4, with an external series-pass transistor, A2Q24, to increase the power handling capability and prevent warm-up voltage drift. A2U4 operates at a very low power dissipation and reaches thermal equilibrium rapidly. Since the internal voltage reference source is specified at ±5% tolerance, no adjustment of the supply voltage is necessary.

-18 V Supply

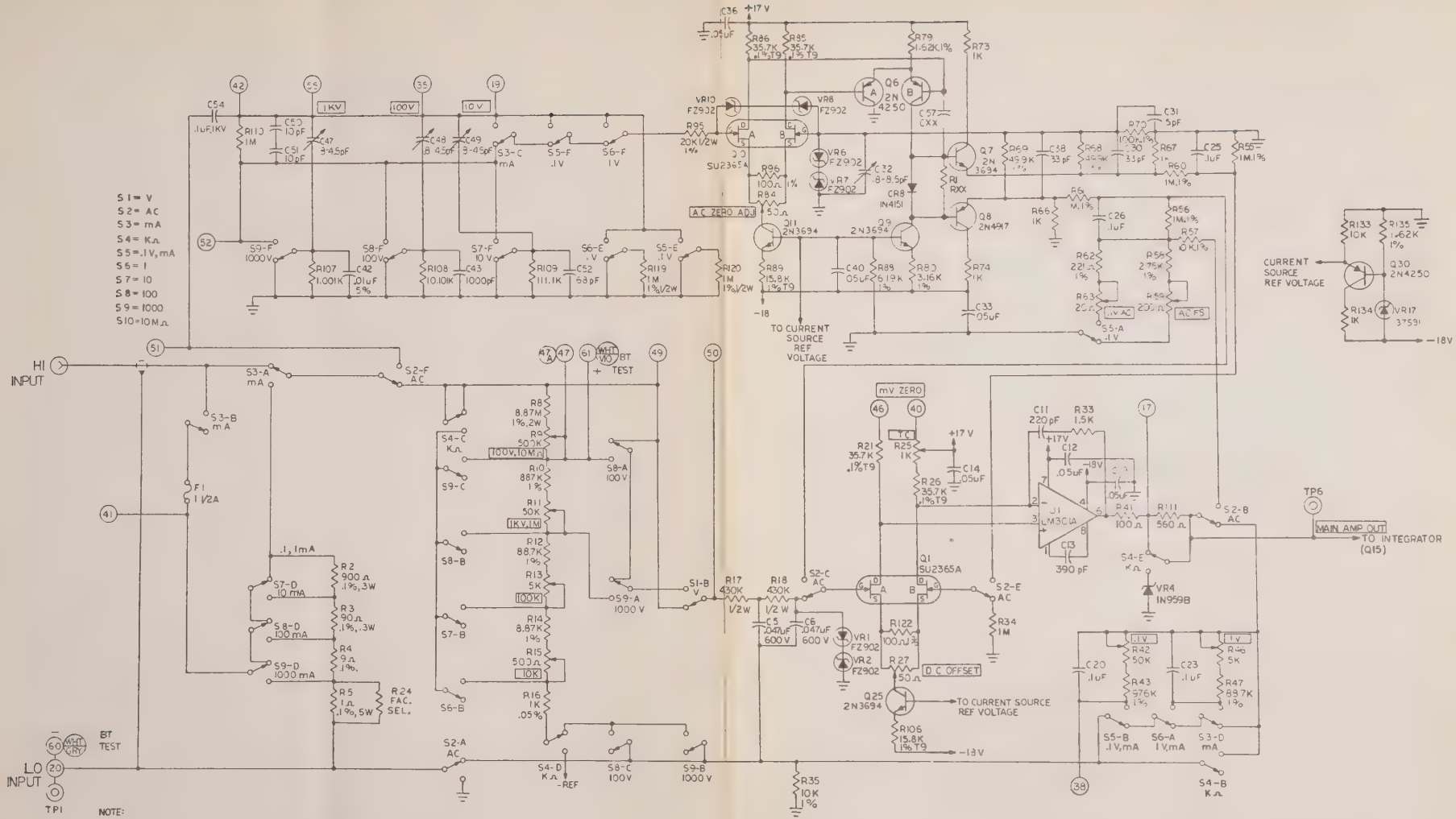
This supply is regulated by integrated circuit A2U5, and external pass transistor Q4. The operation and advantages of this circuit are similar to the +17 V supply.

+200 V Supply

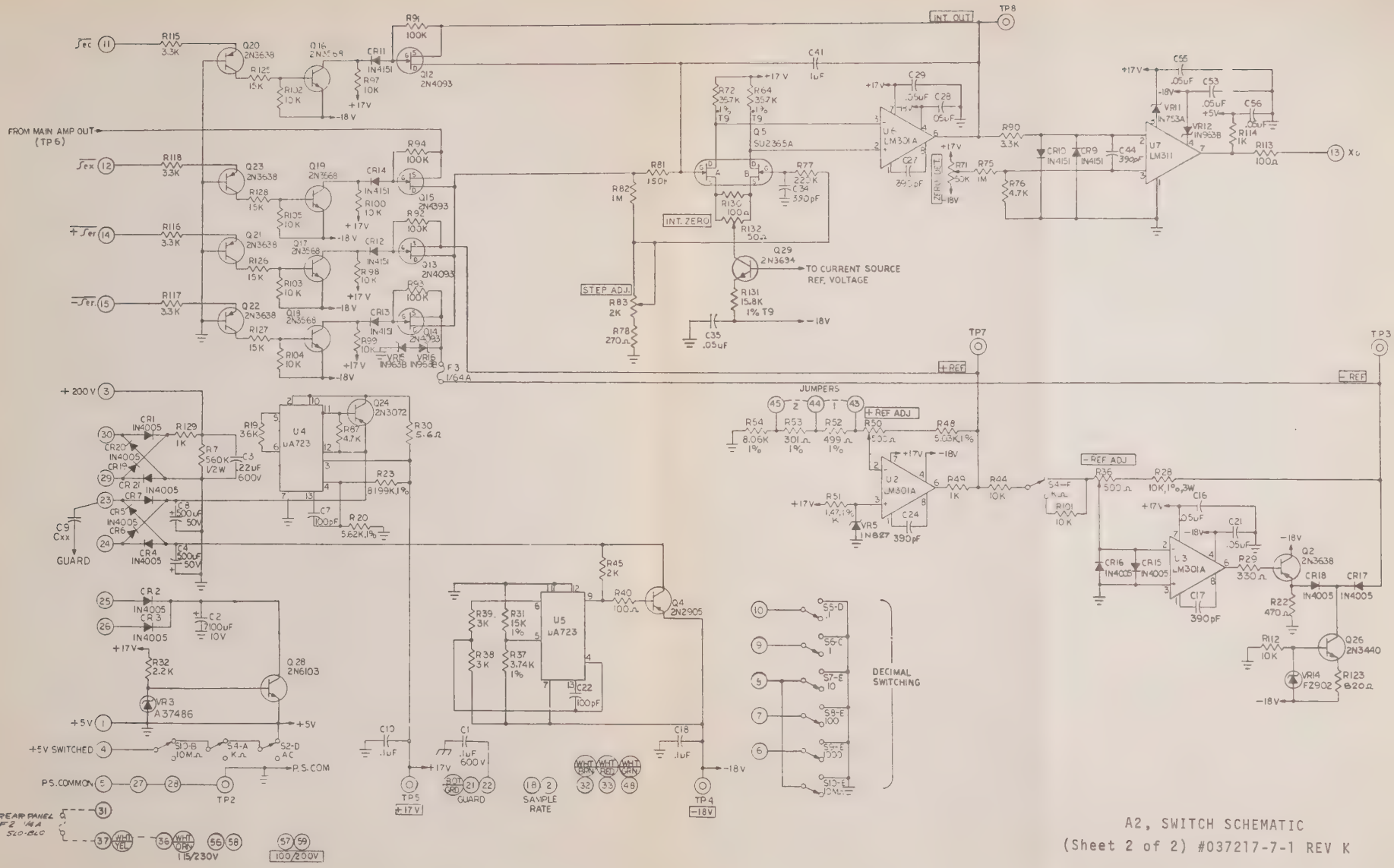
This supply consists of a full wave bridge rectifier, A2CR1, A2CR19, A2CR20, and A2CR21, along with RC filter A2R129 and A2C3, and bleeder resistor A2R7. The output is an essentially unfiltered full wave rectified dc waveform to serve as the readout tube supply voltage. The pulsed operation permits reduced readout tube power dissipation and ensures long tube life.



A2, SWITCH
ASSEMBLY #037217-4-1 REV L

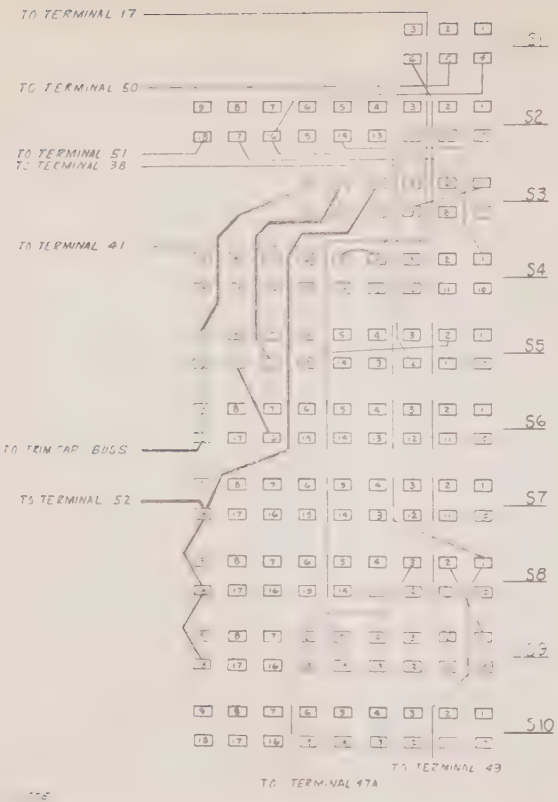


A2, SWITCH SCHEMATIC
(Sheet 1 of 2) #037217-7-1 REV K



A2, SWITCH SCHEMATIC
(Sheet 2 of 2) #037217-7-1 REV K

7004A-8-73



1. WIRES MUST BE ROUTED DIRECTLY AS SHOWN.
2. NO SERVICE LOOPS.
3. HEAVY SHADED WIRES MUST NOT TOUCH ANY UNSHADED WIRES.
4. TYPICAL SWITCH CONFIGURATION
5. HOOKUP WIRE MAY BE 24 GA. BARE WIRE WITH TEFLON SLEEVING OR 24 GA. B TYPE.

A2, S1-S10, SWITCH WIRING SUBASSEMBLY #037217-3-1 REV E

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2	P.C. BOARD: Switch	06811	037217-1-1	1	037217-1-1
A2C1	CAPACITOR, METALIZED MYLAR: .1 µF ±20%, 600 Vdcw	99515	D6-104	1	C0791
A2C2	CAPACITOR, ELECTROLYTIC AXIAL: 7100 µF +100-10%, 10 Vdcw	99392	60C10TA712	1	C1188
A2C3	CAPACITOR, METAL MYLAR: .22 µF ±20%, 600 Vdcw	12406	ZD6A224	1	03286700
A2C4	CAPACITOR, ELECTROLYTIC AXIAL: 500 µF +150-10%, 50 Vdcw	00853	052HJ501X050B	2	C1243
A2C5	CAPACITOR, METALIZED MYLAR: .047 µF ±20%, 600 Vdcw	99515	D6-473	2	C0793
A2C6	CAPACITOR, METALIZED MYLAR: .047 µF ±20%, 600 Vdcw	99515	D6-473	2	C0793
A2C7	CAPACITOR, MICA: 100 pF ±5%, 500 Vdcw, crimp lead	72136	DM15FD101J0	2	C0536
A2C8	CAPACITOR, ELECTROLYTIC AXIAL: 500 µF +150-10%, 50 Vdcw	00853	052HJ501X050B	2	C1243
A2C9	Not used				
A2C10	CAPACITOR, TANT: .1 µF ±20%, 50 Vdcw	56289	5C023104X0500B3	2	C0881
A2C11	CAPACITOR, MICA: 220 pF ±5%, 500 Vdcw, crimp lead	72136	DM15FD221J0	1	C0538
A2C12	CAPACITOR, TANT: .05 µF +80-20%, 50 Vdcw	56289	TGS50	14	C0708

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2C13	CAPACITOR, MICA: 390 pF ±5%, 500 Vdcw	72136	DM15FD391J0	6	C0871
A2C14	CAPACITOR, TANT: .05 µF +80-20, 50 Vdcw	56289	TGS50	14	C0708
A2C15	Not used				
A2C16	CAPACITOR, TANT: .05 µF +80-20%, 50 Vdcw	56289	TGS50	14	C0708
A2C17	CAPACITOR, MICA: 390 pF ±5%, 500 Vdcw	72136	DM15FD391J0	6	C0871
A2C18	CAPACITOR, TANT: .1 µF ±20%, 50 Vdcw	56289	5C023104X0500B3	2	C0881
A2C19	CAPACITOR, TANT: .05 µF +80-20%, 50 Vdcw	56289	TGS50	14	C0708
A2C20	CAPACITOR, METAL MYLAR: .1 µF ±20%, 200 Vdcw	99515	D2-104	4	C0382
A2C21	CAPACITOR, TANT: .05 µF +80-20%, 50 Vdcw	56289	TGS50	14	C0708
A2C22	CAPACITOR, MICA: 100 pF ±5%, 500 Vdcw, crimp lead	72136	DM15FD101J0	2	C0536
A2C23	CAPACITOR, METAL MYLAR: .1 µF ±20%, 200 Vdcw	99515	D2-104	4	C0382
A2C24	CAPACITOR, MICA: 390 pF ±5%, 500 Vdcw	72136	DM15FD39jJ0	6	C0871
A2C25	CAPACITOR, METAL MYLAR: .1 µF ±20%, 200 Vdcw	99515	D2-104	4	C0382

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2C26	CAPACITOR, METAL MYLAR: .1 µF ±20%, 200 Vdcw	99515	D2-104	4	C0382
A2C27	CAPACITOR, MICA: 390 pF ±5%, 500 Vdcw	72136	DM15FD391J0	6	C0871
A2C28	CAPACITOR, TANT: .05 ±F +80-20%, 50 Vdcw	56289	TGS50	14	C0708
A2C29	CAPACITOR, TANT: .05 µF +80-20%, 50 Vdcw	56289	TGS50	14	C0708
A2C30	CAPACITOR, MICA: 33 pF ±5%, 500 Vdcw, crimp lead	72136	DM15ED330J0	2	C0531
A2C31	CAPACITOR, MICA: 5 pF, .5 pF tolerance, 500 Vdcw	72136	DM150D050D0	1	C1071
A2C32	CAPACITOR, VARIABLE GLASS: .8-8.5 pF, P.C. mount	73899	VC9GWY	1	C1291
A2C33	CAPACITOR, TANT: .05 µF +80-20%, 50 Vdcw	56289	TGS50	14	C0708
A2C34	CAPACITOR, MICA: 390 pF ±5%, 500 Vdcw	72136	DM15FD391J0	6	C0871
A2C35	CAPACITOR, TANT: .05 µF +80-20%, 50 Vdcw	56289	TGS50	14	C0708
A2C36	CAPACITOR, TANT: .05 µF +80-20%, 50 Vdcw	56289	TGS50	14	C0708
A2C37	Not used				
A2C38	CAPACITOR, MICA: 33 pF ±5%, 500 Vdcw, crimp lead	72136	DM15ED330J0	2	C0531

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks SD Stock No.
A2C39	Not used				
A2C40	CAPACITOR, TANT: .05 µF +80-20%, 50 Vdcw	56289	TGS50	14	C0708
A2C41	CAPACITOR, POLYSTYRENE: 1.0 µF ±5%, 50 Vdcw	12517	05PA105JS W/SLV	1	C1272
A2C42	CAPACITOR, POLYSTYRENE: .01 µF ±5%, 100 Vdcw	84411	863UW103-5-1W	1	C1295
A2C43	CAPACITOR, MICA: 1000 pF ±5%, 100 Vdcw	72136	DM15FA102J0	1	C1144
A2C44	CAPACITOR, MICA: 390 pF ±5%, 500 Vdcw	72136	DM15FD391J0	6	C0871
A2C45	Not used				
A2C46	Not used				
A2C47	CAPACITOR, VARIABLE GLASS: .8-4.5 pF, P.C. mount	73899	VC10GWY	3	03270200
A2C48	CAPACITOR, VARIABLE GLASS: .8-4.5 pF, P.C. mount	73899	VC10GWY	3	03270200
A2C49	CAPACITOR, VARIABLE GLASS: .8-4.5 pF, P.C. mount	73899	VC10GWY	3	03270200
A2C50	CAPACITOR, MICA: 10 pF ±5%, 500 Vdcw, crimp lead	72136	DM15CD100J0	2	C0527
A2C51	CAPACITOR, MICA: 10 pF ±5%, 500 Vdcw, crimp lead	72136	DM15CD100J0	2	C0527

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2C52	CAPACITOR, MICA: 68 pF ±5%, 500 Vdcw, crimp lead	72136	DM15ED680J0	1	C0635
A2C53	CAPACITOR, TANT: .05 µF +80-20%, 50 Vdcw	56289	TGS50	14	C0708
A2C54	CAPACITOR, METAL MYLAR: .1 µF ±20%, 1200 Vdcw	12406	ZD12A104	1	03286130
A2C55	CAPACITOR, TANT: .05 µF +80-20%, 50 Vdcw	56289	TGS50	14	C0708
A2C56	CAPACITOR, TANT: .05 µF +80-20%, 50 Vdcw	56289	TGS50	14	C0708
A2C57	Not used				
A2CR1	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	14	CR0284
A2CR2	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	14	CR0284
A2CR3	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	14	CR0284
A2CR4	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	14	CR0284
A2CR5	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	14	CR0284
A2CR6	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	14	CR0284
A2CR7	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	07413	1N4005	14	CR0284
A2CR8	SEMICONDUCTOR DEVICE, DIODE: Silicon, 50 Vdcw, 150 mA	03503	1N4151	7	CR0150

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2CR9	SEMICONDUCTOR DEVICE, DIODE: Silicon, 50 Vdcw, 150 mA	03503	1N4151	7	CR0150
A2CR10	SEMICONDUCTOR DEVICE, DIODE: Silicon, 50 Vdcw, 150 mA	03503	1N4151	7	CR0150
A2CR11	SEMICONDUCTOR DEVICE, DIODE: Silicon, 50 Vdcw, 150 mA	03503	1N4151	7	CR0150
A2CR12	SEMICONDUCTOR DEVICE, DIODE: Silicon, 50 Vdcw, 150 mA	03503	1N4151	7	CR0150
A2CR13	SEMICONDUCTOR DEVICE, DIODE: Silicon, 50 Vdcw, 150 mA	03503	1N4151	7	CR0150
A2CR14	SEMICONDUCTOR DEVICE, DIODE: Silicon, 50 Vdcw, 150 mA	03503	1N4151	7	CR0150
A2CR15	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	14	CR0284
A2CR16	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	14	CR0284
A2CR17	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	14	CR0284
A2CR18	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	14	CR0284
A2CR19	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	14	CR0284
A2CR20	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	14	CR0284
A2CR21	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	14	CR0284

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2F1	FUSE: 250 V, 1.5 A	71400	AGX 1 1/2	1	F0046
A2F2	Not used				
A2F3	FUSE: Mini, 125 V, 1/64 A	75915	279.0.5	1	F0069
A2Q1	SEMICONDUCTOR DEVICE, TRANSISTOR: Dual, JFET, N-Channel	15818	SU2365A	3	Q0302
A2Q2	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, PNP	07263	2N3638	5	Q0181
A2Q3	Not used				
A2Q4	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, PNP	04713	2N2905	1	Q0259
A2Q5	SEMICONDUCTOR DEVICE, TRANSISTOR: Dual, JFET, N-Channel	15818	SU2365A	3	Q0302
A2Q6	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, PNP	07263	2N4250	1	26014430
A2Q7	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3694	5	26012660
A2Q8	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, PNP	07263	2N4917	1	26014620
A2Q9	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3694	5	26012660
A2Q10	SEMICONDUCTOR DEVICE, TRANSISTOR: Dual, JFET, N-Channel	15818	SU2365A	3	Q0302
A2Q11	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3694	5	26012660

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2Q12	SEMICONDUCTOR DEVICE, TRANSISTOR: JFET, N-Channel	04713	2N4093	3	Q0301
A2Q13	SEMICONDUCTOR DEVICE, TRANSISTOR: JFET, N-Channel	04713	2N4093	3	Q0301
A2Q14	SEMICONDUCTOR DEVICE, TRANSISTOR: JFET, N-Channel	04713	2N4093	3	Q0301
A2Q15	SEMICONDUCTOR DEVICE, TRANSISTOR: JFET, N-Channel	01295	2N4393	1	Q0316
A2Q16	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3568	4	Q0180
A2Q17	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3568	4	Q0180
A2Q18	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3568	4	Q0180
A2Q19	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3568	4	Q0180
A2Q20	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, PNP	07263	2N3638	5	Q0181
A2Q21	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, PNP	07263	2N3638	5	Q0181
A2Q22	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, PNP	07263	2N3638	5	Q0181
A2Q23	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, PNP	07263	2N3638	5	Q0181
A2Q24	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, PNP	07263	2N3072	1	26008560

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks, SD Stock No.
A2Q25	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3694	5	26012660
A2Q26	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	02735	2N3440	1	Q0319
A2Q27	Not used				
A2Q28	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	02735	2N6103	1	Q0317
A2Q29	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3694	5	26012660
A2Q30	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, PNP	07263	2N4250	1	26014430
A2R1	RESISTOR: Factory select, carbon comp., 1/4 W				RXXXX
A2R2	RESISTOR, METAL FILM: 900 Ω ±.1%, .3 W, 25 PPM	18612	V53-1	1	R2807
A2R3	RESISTOR, METAL FILM: 90 Ω ±.1%, .3 W, 25 PPM	18612	V53-1	1	R2808
A2R4	RESISTOR, METAL FILM: 9.00 Ω ±.1%, .5 W, 25 PPM	18612	V53-5	1	R2809
A2R5	RESISTOR, WIRE WOUND PRECISION: 1 Ω ±.1%, 5 W, 50 PPM	15915	TSA-5W	1	R2810
A2R6	Not used				
A2R7	RESISTOR, COMP: 560 kΩ ±5%, 1/2 W	01121	EB5645	1	R0337
A2R8	RESISTOR, METAL FILM: 8.87 MΩ ±1%, 2 W, 25 PPM	03888	PME80T9	1	R2851

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2R9	RESISTOR, POTENTIOMETER, CERAMIC: 500 kΩ ±10%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR500K	1	R2847
A2R10	RESISTOR, METAL FILM: 887 kΩ ±1%, .25 W, 25 PPM	91637	MFF 1/4 T9	1	R2848
A2R11	RESISTOR, POTENTIOMETER, CERAMIC: 50 kΩ ±10%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR50K	3	R2783
A2R12	RESISTOR, METAL FILM: 88.7 kΩ ±1%, .25 W, 25 PPM	91637	MFF 1/4 T9	2	R2845
A2R13	RESISTOR, POTENTIOMETER, CERAMIC: 5 kΩ ±10%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR5K	2	01111360
A2R14	RESISTOR, METAL FILM: 8.87 kΩ ±1%, .25 W, 25 PPM	91637	MFF 1/4 T9	1	R2840
A2R15	RESISTOR, POTENTIOMETER, CERAMIC: 500 Ω ±10%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR500	3	R2821
A2R16	RESISTOR, METAL FILM: 1.00 kΩ ±.05%, .5 W, -10 PPM	18612	V53-5	1	R2832
A2R17	RESISTOR, COMP: 430 kΩ ±5%, 1/2 W	01121	EB4345	2	R0276
A2R18	RESISTOR, COMP: 430 kΩ ±5%, 1/2 W	01121	EB4345	2	R0276
A2R19	RESISTOR, COMP: 3.6 kΩ ±5%, 1/4 W	01121	CB3625	1	R0938
A2R20	RESISTOR, METAL FILM: 5.62 kΩ ±1%, .12 W, 100 PPM	91637	MFF 1/8 T1	1	R2837

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No
A2R21	RESISTOR, METAL FILM: 35.7 kΩ ±.1%, .12 W, 25 PPM	91637	MFF 1/8 T9	6	R2895
A2R22	RESISTOR, COMP: 470 Ω ±5%, 1/4 W	01121	CB4715	1	R1044
A2R23	RESISTOR, METAL FILM: 8.06 kΩ ±1%, .12 W, 100 PPM	19701	MF5C-D-8061-F	1	R2872
A2R24	RESISTOR, FACTORY SELECT: 820 Ω ±5%, 1/4 W, nominal				RXXXX
A2R25	RESISTOR, POTENTIOMETER, CERAMIC: 1 kΩ ±10%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR1K	1	R2816
A2R26	RESISTOR, METAL FILM: 35.7 kΩ ±.1%, .12 W, 25 PPM	91637	MFF 1/8 T9	6	R2895
A2R27	RESISTOR, POTENTIOMETER, CERAMIC: 50 Ω ±20%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR50	3	R2822
A2R28	RESISTOR, WIRE WOUND PRECISION: 10 kΩ ±1%, 2 W, 10 PPM	15915	TS-2C	1	02421000
A2R29	RESISTOR, COMP: 330 Ω ±5%, 1/4 W	01121	CB3315	1	R0662
A2R30	RESISTOR, COMP: 5.6 Ω ±5%, 1/4 W	01121	CB56G5	1	R2498
A2R31	RESISTOR, METAL FILM: 15.0 kΩ ±1%, .12 W, 100 PPM	19701	MF5C-D-1502-F	1	R2073
A2R32	RESISTOR, COMP: 2.2 kΩ ±5%, 1/4 W	01121	CB2225	1	R0749

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2R33	RESISTOR, COMP: 1.5 kΩ ±5%, 1/4 W	01121	CB1525	1	R0783
A2R34	RESISTOR, COMP: 1 MΩ ±5%, 1/4 W	01121	CB1055	3	R0962
A2R35	RESISTOR, METAL FILM: 10.0 kΩ ±1%, .12 W, 25 PPM	19701	MF5C-E-1002-F	3	R2405
A2R36	RESISTOR, POTENTIOMETER, CERAMIC: 500 Ω ±10%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR500	3	R2821
A2R37	RESISTOR, METAL FILM: 3.7 kΩ ±1%, .12 W, 100 PPM	19701	MF5C-D-3741-F	1	R2824
A2R38	RESISTOR, COMP: 3.0 kΩ ±5%, 1/4 W	01121	CB3025	2	R0711
A2R39	RESISTOR, COMP: 3.0 kΩ ±5%, 1/4 W	01121	CB3025	2	R0711
A2R40	RESISTOR, COMP: 100 Ω ±5%, 1/4 W	01121	CB1015	3	R0966
A2R41	RESISTOR, COMP: 100 Ω ±5%, 1/4 W	01121	CB1015	3	R0966
A2R42	RESISTOR, POTENTIOMETER, CERAMIC: 50 kΩ ±10%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR50K	3	R2783
A2R43	RESISTOR, METAL FILM: 976 kΩ ±1%, .25 W, 25 PPM	91637	MFF 1/4 T9	1	R2849
A2R44	RESISTOR, METAL FILM: 10.0 kΩ ±1%, .12 W, 25 PPM	19701	MF5C-E-1002-F	3	R2405
A2R45	RESISTOR, COMP: 2.0 kΩ ±5%, 1/4 W	01121	CB2025	1	R0734

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks, SD Stock No.
A2R46	RESISTOR, POTENTIOMETER, CERAMIC: 5 kΩ ±10%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR5K	2	01111360
A2R47	RESISTOR, METAL FILM: 88.7 kΩ ±1%, .25 W, 25 PPM	91637	MFF 1/4 T9	2	R2845
A2R48	RESISTOR, METAL FILM: 5.03 kΩ ±.1%, .12 W, 25 PPM	03888	PME60T9	1	R2530
A2R49	RESISTOR, COMP: 1 kΩ ±5%, 1/4 W	01121	CB1025	8	R0765
A2R50	RESISTOR, POTENTIOMETER, CERAMIC: 500 Ω ±10%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR500	3	R2821
A2R51	RESISTOR, METAL FILM: 1.47 kΩ ±1%, .25 W, 100 PPM	91637	MFF 1/4 T1	1	R2833
A2R52	RESISTOR, METAL FILM: 499 Ω ±1%, .25 W, 100 PPM	91637	MFF 1/4 T1	1	R2831
A2R53	RESISTOR, METAL FILM: 301 Ω ±1%, .25 W, 100 PPM	19701	MF6C-D-3010F	1	R2830
A2R54	RESISTOR, METAL FILM: 8.06 kΩ ±1%, .12 W, 25 PPM	03888	PME60T9	1	R2570
A2R55	RESISTOR, METAL FILM: 1.00 MΩ ±1%, .12 W, 100 PPM	19701	MF5C-D-1004-F	4	R2371
A2R56	RESISTOR, METAL FILM: 1.00 MΩ ±1%, .12 W, 100 PPM	19701	MF5C-D-1004-F	4	R2371
A2R57	RESISTOR, METAL FILM: 10.0 kΩ ±1%, .12 W, 25 PPM	19701	MF5C-E-1002-F	3	R2405
A2R58	RESISTOR, METAL FILM: 2.74 kΩ ±1%, .1W, 25 PPM	91637	MF 1/10 T9	1	R1981

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2R59	RESISTOR, POTENTIOMETER, CERAMIC: 200 Ω ±10%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR200	1	R2722
A2R60	RESISTOR, METAL FILM: 1.00 MΩ ±1%, .12 W, 100 PPM	19701	MF5C-D-1004-F	4	R2371
A2R61	RESISTOR, METAL FILM: 1.00 MΩ ±1%, .12 W, 100 PPM	19701	MF5C-D-1004-F	4	R2371
A2R62	RESISTOR, METAL FILM: 221 Ω ±1%, .25 W, 100 PPM	19701	MF6C-D-2210F	1	R2829
A2R63	RESISTOR, POTENTIOMETER, CERAMIC: 20 Ω ±20%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR20	1	R2784
A2R64	RESISTOR, METAL FILM: 35.7 kΩ ±.1%, .12 W, 25 PPM	91637	MFF 1/8 T9	6	R2895
A2R65	Not used				
A2R66	RESISTOR, COMP: 1 kΩ ±5%, 1/4 W	01121	CB1025	8	R0765
A2R67	RESISTOR, COMP: 1 kΩ ±5%, 1/4 W	01121	CB1025	8	R0765
A2R68	RESISTOR, METAL FILM: 49.9 kΩ ±1%, .25 W, 100 PPM	91637	MFF 1/4 T1	2	R2844
A2R69	RESISTOR, METAL FILM: 49.9 kΩ ±1%, .25 W, 100 PPM	91637	MFF 1/4 T1	2	R2844
A2R70	RESISTOR, METAL FILM: 100 kΩ ±1%, .25 W, 100 PPM	91637	MFF 1/4 T1	1	R2846
A2R71	RESISTOR, POTENTIOMETER, CERAMIC: 50 kΩ ±10%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR50K	3	R2783

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2R72	RESISTOR, METAL FILM: 35.7 kΩ ±.1%, .12 W, 25 PPM	91637	MFF 1/8 T9	6	R2895
A2R73	RESISTOR, COMP: 1 kΩ ±5%, 1/4 W	01121	CB1025	8	R0765
A2R74	RESISTOR, COMP: 1 kΩ ±5%, 1/4 W	01121	CB1025	8	R0765
A2R75	RESISTOR, COMP: 1 MΩ ±5%, 1/4 W	01121	CB1055	3	R0962
A2R76	RESISTOR, COMP: 4.7 kΩ ±5%, 1/4 W	01121	CB4725	2	R0892
A2R77	RESISTOR, COMP: 220 kΩ ±5%, 1/4 W	01121	CB2245	1	R0967
A2R78	RESISTOR, COMP: 270 Ω ±5%, 1/4 W	01121	CB2715	1	R0694
A2R79	RESISTOR, METAL FILM: 1.62 kΩ ±1%, .12 W, 100 PPM	91637	MFF-1/8 T1	2	R2834
A2R80	RESISTOR, METAL FILM: 3.16 kΩ ±1%, .12 W, 100 PPM	91637	MFF-1/8 T1	1	R2836
A2R81	RESISTOR, COMP: 150 kΩ ±5%, 1/4 W	01121	CB1545	1	R0961
A2R82	RESISTOR, COMP: 1 MΩ ±5%, 1/4 W	01121	CB1055	3	R0962
A2R83	RESISTOR, POTENTIOMETER, CERAMIC: 2 kΩ ±10%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR2K	1	R2721

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2R84	RESISTOR, POTENTIOMETER, CERAMIC: 50 Ω ±20%, 2/8 W, 15-turn, P.C. mt., end adjust	73138	89PR50	3	R2822
A2R85	RESISTOR, METAL FILM: 35.7 kΩ ±.1%, .12 W, 25 PPM	91637	MFF-1/8 T9	6	R2895
A2R86	RESISTOR, METAL FILM: 35.7 kΩ ±.1%, .12 W, 25 PPM	91637	MFF-1/8 T9	6	R2895
A2R87	RESISTOR, COMP: 4.7 kΩ ±5%, 1/4 W	01121	CB4725	2	R0892
A2R88	RESISTOR, METAL FILM: 6.19 kΩ ±1%, .12 W, 100 PPM	91637	MFF-1/8 T1	1	R2838
A2R89	RESISTOR, METAL FILM: 15.8 kΩ ±1%, .12 W, 25 PPM	91637	MFF-1/8 T9	3	R2896
A2R90	RESISTOR, COMP: 3.3 kΩ ±5%, 1/4 W	01121	CB3325	5	R0742
A2R91	RESISTOR, COMP: 100 kΩ ±5%, 1/4 W	01121	CB1045	4	R0741
A2R92	RESISTOR, COMP: 100 kΩ ±5%, 1/4 W	01121	CB1045	4	R0741
A2R93	RESISTOR, COMP: 100 kΩ ±5%, 1/4 W	01121	CB1045	4	R0741
A2R94	RESISTOR, COMP: 100 kΩ ±5%, 1/4 W	01121	CB1045	4	R0741
A2R95	RESISTOR, METAL FILM: 20.0 kΩ ±1%, .5 W, 100 PPM	91637	MFF-1/2 T1	1	02379680
A2R96	RESISTOR, METAL FILM: 100 Ω ±1%, .25 W, 100 PPM	MIL	RN65D1000F	2	R2620

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2R97	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	11	R0766
A2R98	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	11	R0766
A2R99	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	11	R0766
A2R100	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	11	R0766
A2R101	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	11	R0766
A2R102	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	11	R0766
A2R103	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	11	R0766
A2R104	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	11	R0766
A2R105	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	11	R0766
A2R106	RESISTOR, METAL FILM: 15.8 kΩ ±1%, .12 W, 25 PPM	91637	MFF-1/8 T9	3	R2896
A2R107	RESISTOR: Part of set, 1.001 kΩ	06811	037225-6-1	1	037225-6-1
A2R108	RESISTOR: Part of set, 10.101 kΩ	06811	037225-6-1	1	037225-6-1
A2R109	RESISTOR: Part of set, 111.1 kΩ	06811	037225-6-1	1	037225-6-1

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2R110	RESISTOR: Part of set, 1 MΩ	06811	037225-6-1	1	037225-6-1
A2R111	RESISTOR, COMP: 560 Ω ±5%, 1/4 W	01121	CB5615	1	R0819
A2R112	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	11	R0766
A2R113	RESISTOR, COMP: 100 Ω ±5%, 1/4 W	01121	CB1015	3	R0966
A2R114	RESISTOR, COMP: 1 kΩ ±5%, 1/4 W	01121	CB1025	8	R0765
A2R115	RESISTOR, COMP: 3.3 kΩ ±5%, 1/4 W	01121	CB3325	5	R0742
A2R116	RESISTOR, COMP: 3.3 kΩ ±5%, 1/4 W	01121	CB3325	5	R0742
A2R117	RESISTOR, COMP: 3.3 kΩ ±5%, 1/4 W	01121	CB3325	5	R0742
A2R118	RESISTOR, COMP: 3.3 kΩ ±5%, 1/4 W	01121	CB3325	5	R0742
A2R119	RESISTOR, METAL FILM: 1.00 MΩ ±1%, .5 W, 100 PPM	19701	MF7C-D-1004-F	2	02381310
A2R120	RESISTOR, METAL FILM: 1.00 MΩ ±1%, .5 W, 100 PPM	19701	MF7C-D-1004-F	2	02381310
A2R121	Not used				
A2R122	RESISTOR, METAL FILM: 100 Ω ±1%, .25 W, 100 PPM	MIL	RN65D1000F	2	R2620
A2R123	RESISTOR, COMP: 820 Ω ±5%, 1/4 W	01121	CB8215	1	R0762

REPLACEABLE PARTS LIST

Equipment/Assembly Designation: A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2R124	Not used				
A2R125	RESISTOR, COMP: 15 kΩ ±5%, 1/4 W	01121	CB1535	4	R0728
A2R126	RESISTOR, COMP: 15 kΩ ±5%, 1/4 W	01121	CB1535	4	R0728
A2R127	RESISTOR, COMP: 15 kΩ ±5%, 1/4 W	01121	CB1535	4	R0728
A2R128	RESISTOR, COMP: 15 kΩ ±5%, 1/4 W	01121	CB1535	4	R0728
A2R129	RESISTOR, COMP: 1 kΩ ±5%, 1/4 W	01121	CB1025	8	R0765
A2R130	RESISTOR, COMP: 100 Ω ±5%, 1/4 W	01121	CB1015	1	R0966
A2R131	RESISTOR, METAL FILM: 15.8 kΩ ±1%, .12 W, 25 PPM	91637	MFF-1/8 T9	3	R2896
A2R132	RESISTOR, POTENTIOMETER, CERAMIC: 50 Ω ±20%, 3/8 W, 15-turn, P.C. mt., end adjust	73138	89PR50	3	R2822
A2R133	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	11	R0766
A2R134	RESISTOR, COMP: 1 kΩ ±5%, 1/4 W	01121	CB1025	8	R0765
A2R135	RESISTOR, METAL FILM: 1.62 kΩ ±1%, .12 W, 100 PPM	91637	MFF-1/8 T1	2	R2834
A2TP1	TEST POINT: Brown, P.C. mt. parallel	91506	8041-1G3	1	E0235

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2TP2	TEST POINT: Black, P.C. mt. parallel	91506	8041-1G6	1	E0234
A2TP3	TEST POINT: Orange, P.C. mt. parallel	91506	8041-1G5	1	E0237
A2TP4	TEST POINT: Yellow, P.C. mt. parallel	91506	8041-1G2	1	E0238
A2TP5	TEST POINT: Green, P.C. mt. parallel	91506	8041-1G7	1	E0239
A2TP6	TEST POINT: Blue, P.C. mt. parallel	91506	8041-1G8	1	E0240
A2TP7	TEST POINT: Violet, P.C. mt. parallel	91506	8041-1G11	1	E0241
A2TP8	TEST POINT: Grey, P.C. mt. parallel	91506	8041-1G10	1	E0242
A2U1	INTEGRATED CIRCUIT: Operational amplifier	27014	LM301AH	4	025745
A2U2	INTEGRATED CIRCUIT: Operational amplifier	27014	LM301AH	4	025745
A2U3	INTEGRATED CIRCUIT: Operational amplifier	27014	LM301AH	4	025745
A2U4	INTEGRATED CIRCUIT: Voltage regulator	27014	LM723CN	2	025761
A2U5	INTEGRATED CIRCUIT: Voltage regulator	27014	LM723CN	2	025761
A2U6	INTEGRATED CIRCUIT: Operational amplifier	27014	LM301AH	4	025745

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2U7	INTEGRATED CIRCUIT: Medium scale complementary	27014	LM311H	1	025792
A2VR1	SEMICONDUCTOR DEVICE, DIODE, ZENER: 6.5 Vdcw, ±10%, .1 W	13715	FZ902	7	26015850
A2VR2	SEMICONDUCTOR DEVICE, DIODE, ZENER: 6.5 Vdcw, ±10%, .1 W	13715	FZ902	7	26015850
A2VR3	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, PNP	06811	037486	1	37486
A2VR4	SEMICONDUCTOR DEVICE, DIODE, ZENER: 8.2 Vdcw, ±5%, .4 W	04713	1N9598	1	R0346
A2VR5	SEMICONDUCTOR DEVICE, DIODE, REFERENCE: 6.2 Vdcw, ±.001%/C	99942	1N827	1	R0162
A2VR6	SEMICONDUCTOR DEVICE, DIODE, ZENER: 6.5 Vdcw, ±10%, .1 W	13715	FZ902	7	26015850
A2VR7	SEMICONDUCTOR DEVICE, DIODE, ZENER: 6.5 Vdcw, ±10%, .1 W	13715	FZ902	7	26015850
A2VR8	SEMICONDUCTOR DEVICE, DIODE, ZENER: 6.5 Vdcw, ±10%, .1 W	13715	FZ902	7	26015850
A2VR9	Not used				
A2VR10	SEMICONDUCTOR DEVICE, DIODE, ZENER: 6.5 Vdcw, ±10%, .1 W	13715	FZ902	7	26015850
A2VR11	SEMICONDUCTOR DEVICE, DIODE, ZENER: 6.2 Vdcw, ±5%, .4 W	03877	1N753A	1	CR0163
A2VR12	SEMICONDUCTOR DEVICE, DIODE, ZENER: 12 Vdcw, ±5%, .4 W	04713	1N963B	2	CR0174

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A2VR13	Not used				
A2VR14	SEMICONDUCTOR DEVICE, DIODE, ZENER: 6.5 Vdcw, ±10%, .1 W	13715	FZ902	7	26015850
A2VR15	SEMICONDUCTOR DEVICE, DIODE, ZENER: 12 Vdcw, ±5%, .4 W	04713	1N963B	2	CR0174
A2VR16	SEMICONDUCTOR DEVICE, DIODE, ZENER: 20 Vdcw, ±5%, .4 W	04713	1N968B	1	CR0265
A2VR17	SEMICONDUCTOR DEVICE, DIODE, ZENER: 6.35 Vdcw, .15 V, 7 mA	06811	Coded Green Dot	1	037591
A2XU4	INTEGRATED CIRCUIT SOCKET: 7-terminal strip	27264	1938-4B-7	4	X0184
A2XU5	INTEGRATED CIRCUIT SOCKET: 7-terminal strip	27264	1938-4B-7	4	X0184
	CONNECTOR, P.C.: Single pin 10/inch, male post	00779	86090-4	7	E0322
	SPACER: Swage, 6-32	88245	1530 B 5/8	4	E0228
	CLIP, FUSE: Single, P.C. mt.	91506	6027-2CT	2	36011810
	TERMINAL: Swage bifurcated	88245	2000B	53	E0100
	EYELET	04264	CE-43	2	E0176
	TERMINAL, PRESS	71279	4034-3-0519	9	51024460
	HEATSINK	13103	1115 B	2	H2050
	INTEGRATED CIRCUIT INSULATOR	06811	039466-4	4	039466-4
	TIE, ANCHOR	06383	TMIS6	1	37021790
	PAD TRANSISTOR	08289	501-000-D	12	H0515

REPLACEABLE PARTS LIST

Equipment/Assembly Designation A2, SWITCH #037217-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks SD Stock No.
	TIE, CABLE: Nylon	06383	SSTIM	4	H1104
	SCREW, PAN HEAD MACHINE: 6-32 X 3/8	MIL	MS51957-28	1	H0989
	TIE, CABLE	06383	SST1.5I	1	H2102
	SCREW, PAN HEAD MACHINE: 4-40 X 5/16	MIL	MS51957-14	1	H1273
	WASHER: Split-lock #4	MIL	MS35338-135	1	H0782
	WASHER: Flat #6	MIL	MS15795-805	1	H0759
	WASHER: Split-lock #6	MIL	MS35338-136	1	H0783
	NUT: Hex 6-32	MIL	NAS671C6	1	H0380
	NUT: Hex 4-40	MIL	NAS671C4	1	H0249

REPLACEABLE PARTS LIST

Equipment/Assembly Designation SWITCH WIRING SUB #037217-3-1

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
S1 thru S10	ASSEMBLY, SWITCH	06811	037721	1	037721
	ASSEMBLY, SWITCH	06811	037720	1	037220

CHAPTER 6
OPTIONS AND ACCESSORIES

6.1 INTRODUCTION

This chapter contains descriptions of the standard options and accessories available for the Model 7004A Digital Multimeter. The two options described in this chapter are Option 05, Digital Outputs and Option 09, Battery Pack. The accessories include the three foot, color coded input test leads, the single rack mount kit, the dual rack mount kit, the protective front panel snap cover, and the leather carrying case (not shown).

TABLE 6.1 OPTIONS AND ACCESSORIES DRAWING INDEX

Option	Description	Drawing	Page #
Opt 05	BCD Assembly	037218-4-1	OPT 05-3
	Schematic	037218-7-1	OPT 05-4
	Parts List	037218-4-1	OPT 05-5
Opt 09	Battery Pack Assembly	037219-4-1	OPT 09-3
	Parts List	037219-4-1	OPT 09-4
Opt 09	A3, Battery Pack Assembly	037469-4-1	OPT 09-5
	Schematic	037469-7-1	OPT 09-6
	Parts List	037469-4-1	OPT 09-7
	Accessory, Test Probe Kit Ass'y	037232-4-1	ACC-2
	Parts List	037232-4-1	ACC-3
	Accessory, Single Rack Mount Assembly	045410-3	ACC-5
	Parts List	045410-3	ACC-6
	Accessory, Dual Rack Mount Ass'y	037492-3	ACC-8
	Parts List	037492-4-1	ACC-9
	Accessory, Front Cover Assembly	037229-4-1	ACC-11
	Parts List	037229-4-1	ACC-12

CIRCUIT DESCRIPTION
OPTION 05, DIGITAL OUTPUTS (BCD)
SCHEMATIC #037218-7-1

This option provides non-isolated 1-2-4-8 BCD outputs and recorder control signals with DTL/TTL compatible logic levels. The input signal LOW and the BCD PS COMMON are tied together through a low internal impedance. Some degradation of common mode voltage and noise rejection should be anticipated when connected to an unbuffered or non-isolated recording device. Note: the outputs are not short circuit proof.

The outputs on J202, rear panel connector (AMPHENOL #57-40240) provide four BCD digits, V2 (10^3), V3 (10^2), V4 (10^1), and V5 (10^0) with one line (true) each for OVERRANGE, MINUS POLARITY, and PRINT COMMAND. Binary "0" or "False" is greater than +2.4 volts with a 200 μA source. The binary "1" or "True" is 0 to +0.5 volts with a 8 mA sink.

The inputs on J202 are all single lines with the "false" state accepting ground true logic. The external READ ON COMMAND line produces a single measurement per command. The INHIBIT line and the STOP line inhibit or complete the measurement cycle.

BCD PIN ASSIGNMENTS

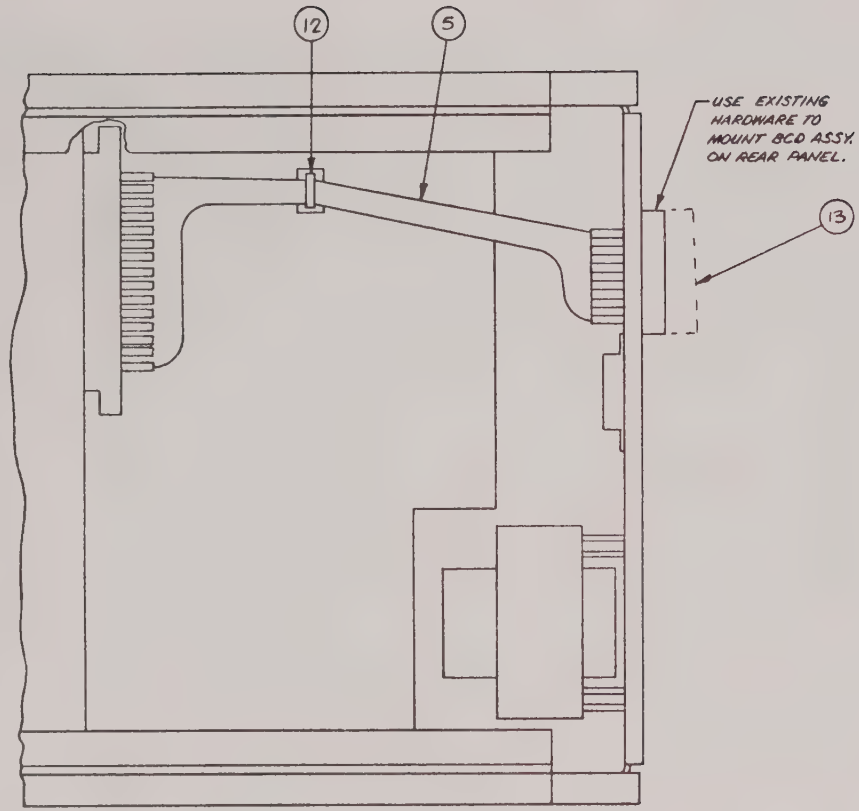
J202 Pin	5103 (SD Printer) J2	Function
7	7	$\overline{1}$
8	8	$\overline{2}$ — V2 (10^3)
19	32	$\overline{4}$
20	33	$\overline{8}$
5	5	$\overline{1}$
6	6	$\overline{2}$ — V3 (10^2)
17	30	$\overline{4}$
18	31	$\overline{8}$
3	3	$\overline{1}$
4	4	$\overline{2}$ — V4 (10^1)
15	28	$\overline{4}$
16	29	$\overline{8}$

BCD PIN ASSIGNMENTS (Cont'd)

J202 Pin	5103 (SD Printer) J2	Function
1	1	$\overline{1}$
2	2	$\overline{2}$ — V5 (10^0)
13	26	$\overline{4}$
14	27	$\overline{8}$
24	49,50	$\overline{\text{PS COMMON}}$
21	21	$\overline{\text{MINUS POLARITY}}$
9	9	$\overline{\text{OVERRANGE}}$
23	48	$\overline{\text{PRINT COMMAND}}$
11	N.C.	$\overline{\text{READ ON COMMAND}}$
22	49,50 switched	$\overline{\text{STOP}}$
10	47	$\overline{\text{INHIBIT}}$

Notes:

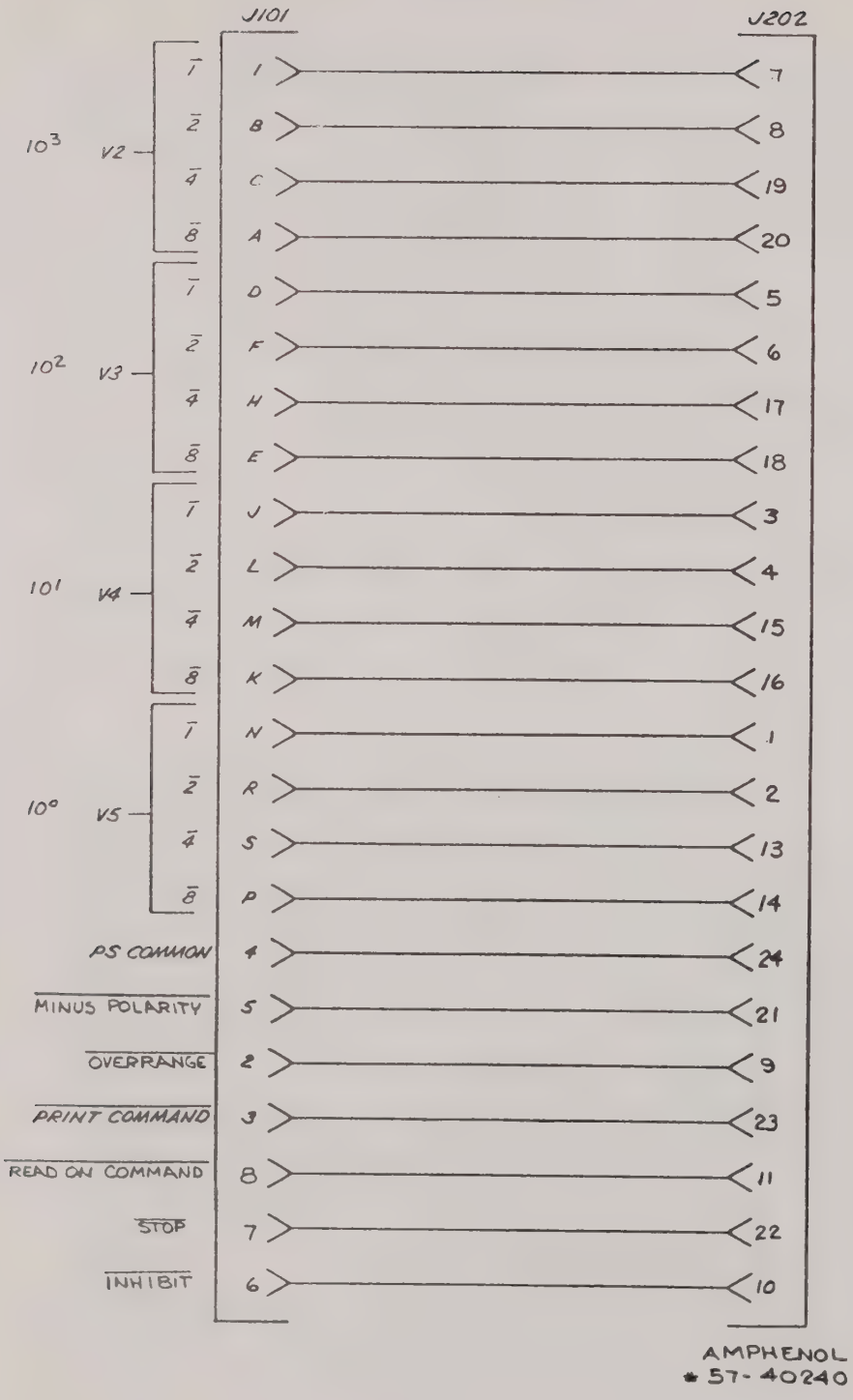
1. Grounds in Model 5103 must be isolated.
2. Negative readings are printed in red.
3. BCD Outputs (Option 05) are not isolated from the Analog section. It is imperative that the printer or other data receiver inputs be electrically isolated from the DMM input and chassis. A short between printer low and chassis ground or 7004A input low will result in improper operation and invalid display. Any significant capacitance or induced noise, such as 60 Hz power line voltage, between chassis and printer low will induce some noise in the display on sensitive ranges. Typical noise levels may be ±10 counts on the 0.1 and 1 V ranges and proportionally less on higher ranges.



NOTES:

1. REMOVE BCD COVER PLATE ON REAR PANEL.
2. REMOVE UNIT TOP COVER, TOP GUARD COVER & BATTERY PACK IF INSTALLED.
3. LIFT UP READOUT BD. AND CONNECT BCD CABLE AS SHOWN.
4. CUT OLD PLASTIC TIE & TIE CABLE TO ANCHOR USING NEW PLASTIC TIE.
5. ADD -05 TO UNIT LABEL ON REAR PANEL.

OPTION 05, BCD ASSEMBLY #037218-4-1 REV A



OPTION 05, BCD SCHEMATIC #037218-7-1 REV A

REPLACEABLE PARTS LIST

Equipment/Assembly Designation: OPT 05, BCD #037218-4-1

(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
ITEM	REF					
5		ASSEMBLY, CABLE BCD	06811	037218-3-1	1	037218-3-1
12		TIE, CABLE: Nylon	06383	SSTIM	1	H1104
13	P201	CONNECTOR: 24-pin, male plug	02660	57-30240	1	J0244
	J101	CONNECTOR: Dual, 15-position	05574	2VH15/1AN5	1	J0504
	J202	CONNECTOR: 24-pin, female chassis receptacle	02660	57-40240	1	J0298

CIRCUIT DESCRIPTION
OPTION 09, BATTERY PACK
FINAL ASSEMBLY #037219-4-1

The Option 09 Battery Pack allows operation of the Model 7004A Multimeter for up to six hours from the self contained storage batteries before necessary re-charging. The Battery Pack circuitry has two major sections, a dc to ac inverter and an automatic battery charger. (Note: Install fuse A3F1 on inverter board.)

DC TO AC INVERTER (SCHEMATIC 37469-7-1)

The dc to ac inverter circuit is a current limited, short circuit proof, driven inverter providing high efficiency power conversion and reliable operation. Excessive load current drain on any transformer winding due to another circuit failure or an inadvertant short circuit will not damage the inverter. Conventional square wave inverter operation is not used. Instead, each driver transistor conducts only 25% of the duty cycle, which produces a square wave when full wave rectified. This technique permits reliable operation of the readout tubes at reduced power levels from that required for conventional dc operation. Operating the tubes on a pulsed basis also allows high peak currents to prevent partial number glow due to cathode sublimation after long service life while still permitting low average power consumption.

The 25% duty cycle waveforms with 180° phase displacement drive the push-pull inverter power transistors, A3Q3 and A3Q4. These waveforms are derived from a square wave clock generator, A3U1, followed by a two stage ripple counter composed of a dual J-K flip-flop A3U2 and appropriate logic circuitry A3U1. The basic square wave clock frequency is approximately 400 Hz producing an inverter drive frequency of 100 Hz, non-square wave.

Current limiting and overload protection is provided in this circuit. Since normal current levels through A3R7 will not develop sufficient voltage to exceed the base-emitter turn-on threshold voltage, A3Q1 is normally off. If an output overload causes excessive conduction through power transistors A3Q3 and A3Q4, the voltage developed across A3R7 will increase and turn on A3Q1. The drive current is then shunted from the bases of the power transistors, thereby limiting the current they deliver. In the event of an inverter malfunction, further protection is provided by Fuse A3F1. An output load short will not blow A3F1 when the inverter is functioning properly, since the battery current drain is limited by the action of A3Q1.

A3Q6, A3CR8, and A3Q7 with associated components perform the dual function of regulating the +5 V logic voltage and serve as an electronic power switch to turn the inverter drive on or off depending on whether BATTERY or LINE operation has been selected.

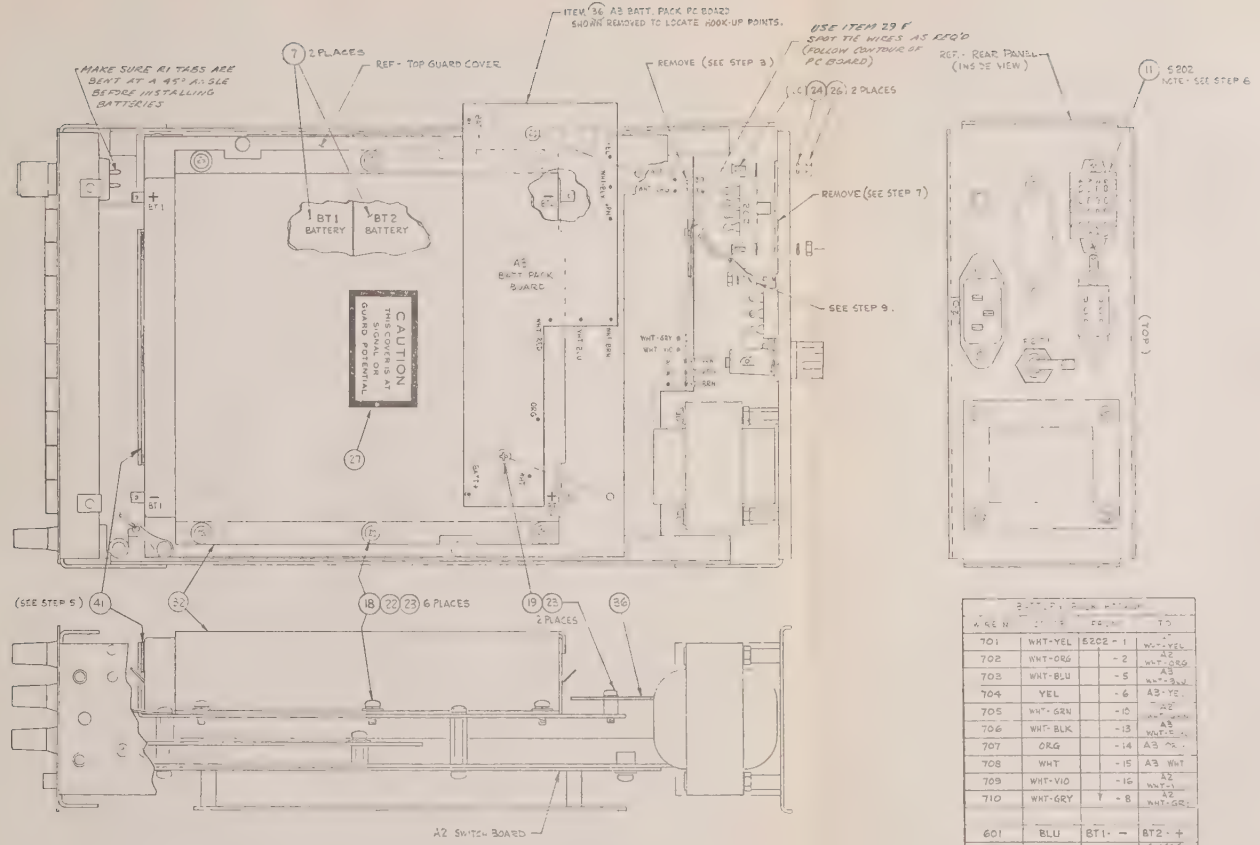
AUTOMATIC BATTERY CHARGER

The charger circuit is automatic and is connected to the battery when the instrument is operated on the power line. This circuit will provide a constant current charge to a discharged battery until it reaches a full charge condition. At the full charge condition the current tapers off to provide a constant FLOAT voltage of 13.7 to 13.8 V which is the ideal standby condition for maximum battery life. Since the FLOAT voltage is very accurately maintained, the battery remains fully charged. A completely discharged battery requires approximately 16 hours to recharge.

The charger circuit consists of an integrated circuit voltage regulator A3U3, power transistor A3Q8, current sensing resistor A3R16, voltage sensing resistor divider A3R17, A3R18, and FLOAT voltage adjustment potentiometer A3R19. The same transformer winding driven by the inverter circuit in battery operation is utilized as a charger voltage supply when the instrument is operated from the ac power lines. A full wave bridge rectifier A3CR1, A3CR2, A3CR3, and A3CR4 supplies an unfiltered dc input to the regulator circuit. Current limited pulses are fed to the battery through rectifier A3CR7 when the battery is charging. Constant voltage amplitude pulses are applied through A3CR7 when the battery charge condition is high enough so the current drawn does not produce current limiting in the regulator.

The battery FLOAT voltage is set at 13.7 to 13.8 volts at the factory and should normally not require attention. If readjustment of the FLOAT voltage should be required substitute a large electrolytic capacitor of at least 5,000 μF paralleled with a 10 kΩ resistor for the battery. Monitor the voltage across the capacitor with the DMM and adjust the voltage to 13.7-13.8 V. This adjustment is very difficult to perform in any reasonable period of time with a battery connected to the charger.

The BATTERY TEST position on the rear panel slide switch S202 operates the instrument on its own internal batteries and displays the battery voltage under normal load on the readout. The end-of-life battery voltage is approximately 11 volts. Normal full charge voltage will be in excess of 12.5 volts under load. The instrument should be on the 10 VDC range and function with nothing connected to the input terminals when BATTERY TEST is operated. If the battery voltage will not operate the instrument, the battery voltage may be measured directly across the input terminals using a very high impedance volt meter. Approximately 9 megohms resistance is in series between the battery + terminal and the input HIGH terminal to prevent damage to the internal battery or an external source, so loading error must be considered when using an external meter.


MAKE SURE RI TABS ARE BENT AT A 45° ANGLE BEFORE INSTALLING BATTERIES
7 2 PLACES
REF - TOP GUARD COVER
ITEM 36 A3 BATT. PACK PC BOARD SHOWN REMOVED TO LOCATE HOOK-UP POINTS.
REMOVE (SEE STEP 8)
USE ITEM 29 F SPOT TIE WIRES AS REQ'D (FOLLOW CONTOUR OF PC BOARD)
REF - REAR PANEL (INSIDE VIEW)
11 S202 NOTE - SEE STEP 6
24 26 2 PLACES
REMOVE (SEE STEP 7)
BT1 BATTERY
BT2 BATTERY
A3 BATT PACK BOARD
CAUTION THIS COVER IS AT GUARD POTENTIAL
SEE STEP 9.
27
(SEE STEP 5) 41
32
18 22 23 6 PLACES
19 23 2 PLACES
36
A2 SWITCH BOARD

WIRE NO.	COLOR	FROM	TO
701	WHT-YEL	S202 - 1	A2 WHT-YEL
702	WHT-ORG	- 2	A2 WHT-ORG
703	WHT-BLU	- 5	A3 WHT-BLU
704	YEL	- 6	A3-YEL
705	WHT-GRN	- 10	A2 WHT-GRN
706	WHT-BLK	- 13	A3 WHT-BLK
707	ORG	- 14	A3 ORG
708	WHT	- 15	A3 WHT
709	WHT-VIO	- 16	A2 WHT-VIO
710	WHT-GRY	- 8	A2 WHT-GRY
601	BLU	BT1 -	BT2 +
602	GRN	A3 - GRN	CHASSIS GROUND
[illegible]	WHT-BRN	A3 WHT-GRN	A2 WHT-BRN
[illegible]	WHT-RED	A3 WHT-RED	A2 WHT-RED
508	BLK	A3-BATT -	BT2 -
510	RED	A3-BATT+	BT1 +

NOTES:

1. A [illegible] AC LINE CORD, AND A [illegible] ARE SHOWN.

NOTICE

ON UNITS WITH LINE FUSE ON A2 PC BD. SERIAL #101 to 656.

Red wire of shielded cable must be on A2 terminal 36.

ON UNITS WITH LINE FUSE ON REAR PANEL SERIAL #657 ON.

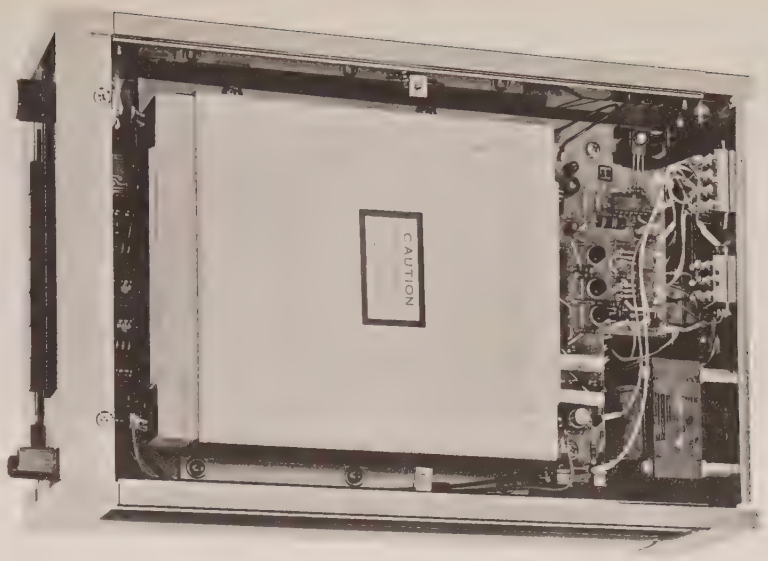
Red wire of shielded cable must be on A2 terminal 37.

To insure safe operation of unit in battery mode, check with an AC meter from each terminal to the other terminals of J201. If line voltage is present, check wiring per above.

INSTALLATION PROCEDURE

1. REMOVE THE AC LINE CORD.
2. REMOVE THE TOP AND BOTTOM UNIT COVERS.
3. REMOVE JUMPER WIRE BETWEEN TERMINALS NO. 36 & 37 ON A2 SWITCH BOARD. SEE NOTICE.
4. RE-INSTALL THE BOTTOM UNIT COVER.
5. APPLY ITEM 41, FOAM TAPE; BEHIND AND ALONG TOP FLANGE OF THE TOP GUARD COVER.
6. POSITION BATTERIES BT1 & BT2 ON THE TOP GUARD COVER; NOTE + & - TABS ON EACH BATTERY. SECURE THE BATTERIES IN PLACE AND BACK-TO-BACK WITH THE BATTERY CLAMP ASSEMBLY, ITEM NO. 32.
7. REMOVE SWITCH PLATE ON THE REAR PANEL.
8. INSTALL SWITCH (S202) ASSEMBLY, ITEM NO.11 ON THE REAR PANEL. SWITCH MUST BE MOUNTED WITH THE WHT-YEL WIRE AT LUG #1. SEE REAR PANEL VIEW. SET SWITCH TO "OFF".
9. REMOVE NUT AND WASHER OF THE "LINE" SWITCH AND INSTALL THE GROUND LUG OF WIRE NO. 602 (GRN). BEND LUG AS REQUIRED.
10. CONNECT ALL WIRE ENDS WHICH GO TO A2 SWITCH BOARD. SEE HOOK-UP TABLE ABOVE.
11. REMOVE THE 1.5 AMP. FUSE (F4) ON THE BATTERY PACK P.C. ASSEMBLY A3, ITEM NO. 36. SET THIS FUSE ASIDE.
12. MOUNT THE BATTERY PACK P.C. BOARD ASSEMBLY A3 ON THE TOP GUARD COVER AS INDICATED.
13. HOOK UP THE REMAINING TERMINATIONS PER THE ABOVE TABLE.
14. RE-INSTALL THE 1.5A FUSE ON THE BATTERY PACK P.C. BOARD ASSEMBLY A3. IN HOUSE UNITS (SYSTRON DONNER) INSTALL AT TEST. SEE NOTICE
15. APPLY THE "CAUTION" LABEL, ITEM NO. 27 AS SHOWN.
16. RE-INSTALL THE TOP COVER ON THE UNIT.
17. MARK THE IDENTIFICATION LABEL ON THE REAR PANEL AS MODEL "7004-09 OPT.".
18. RE-INSTALL THE AC LINE CORD.

OPTION 09, BATTERY PACK
ASSEMBLY #037219-4-1 REV C



BATTERY PACK, INSTALLED VIEW

REPLACEABLE PARTS LIST

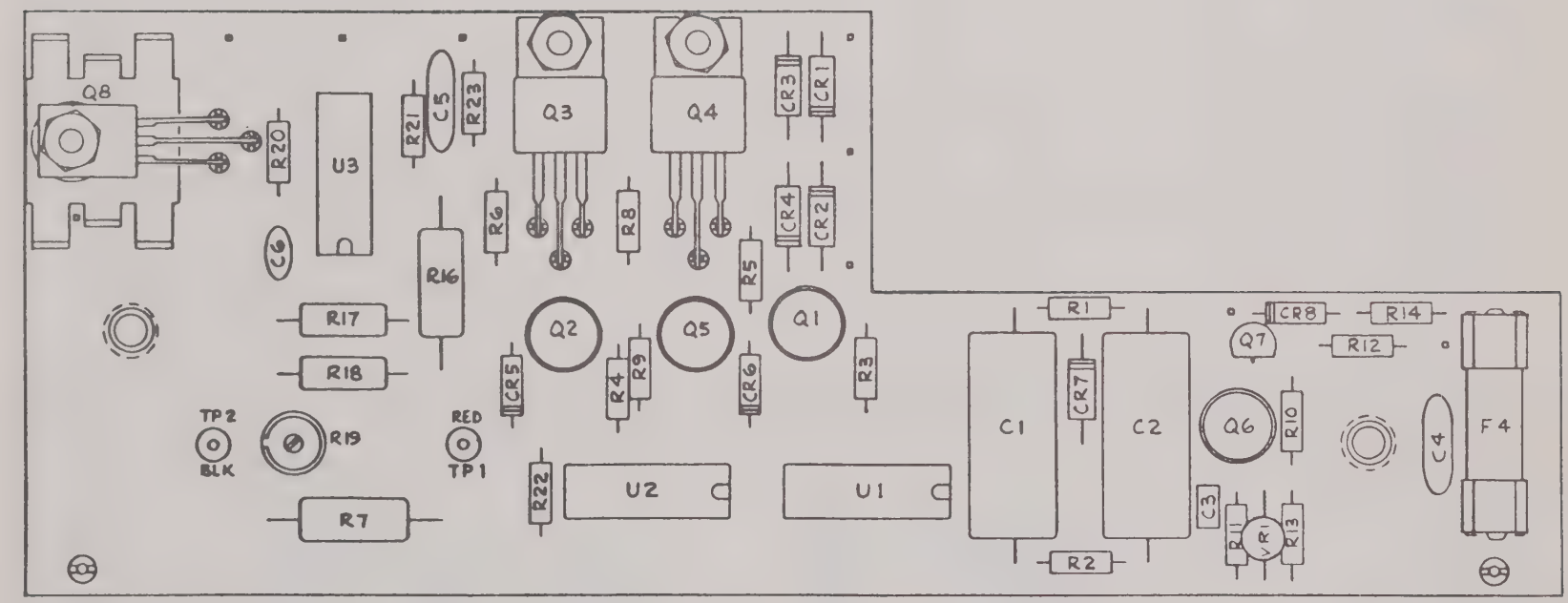
Equipment/Assembly Designation OPT 09, BATTERY PACK #037219-4-1

ITEM	(1) Reference Designation REF	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
3		TERMINAL, WIRE: Female taper, crimp, 26-24GA	00779	A-85897-1	15	E0334
4		LUG: Ground #4	79963	9-.120	1	H0539
5		TERMINAL, WIRE: Female taper, non-insulated, 22-18GA	79061	18204	2	H1967
6		TUBING: Shrink	06811	By description	1	T-15
7	BT-1	BATTERY: 6 V, 4.5 Ah, gell cell	25244	GC645-1	2	BT0005
7	BT-2	BATTERY: 6 V, 4.5 Ah, gell cell	25244	GC645-1	2	BT0005
11		ASSEMBLY, BATTERY SWITCH	06811	037228-4-1	1	037228-4-1
12		SWITCH, SLIDE	82389	4931L7 32KNOB	1	S0415
18		SCREW, PAN HEAD MACHINE: 6-32 X 5/16	MIL	MS51957-27	6	H1281
19		SCREW, PAN HEAD MACHINE: 6-32 X 5/8	MIL	MS51957-26	2	H0966
20		SCREW, FLAT HEAD MACHINE: 2-56 X 1/4, 100°	MIL	AN507-C256-R4	2	H1156
22		WASHER: Flat #6	MIL	MS15795-805	6	H0759
23		WASHER: Split-lock #6	MIL	MS35338-136	8	H0783
24		WASHER: Split-lock #2	MIL	MS35337-77	2	H0481
26		NUT: Hex 2-56	08547	By description	2	H0377
27		LABEL, CAUTION	06811	037471-6-1	1	037471-6-1
29		TIE, CABLE: Nylon	06383	SSTIM	A/R	H1104

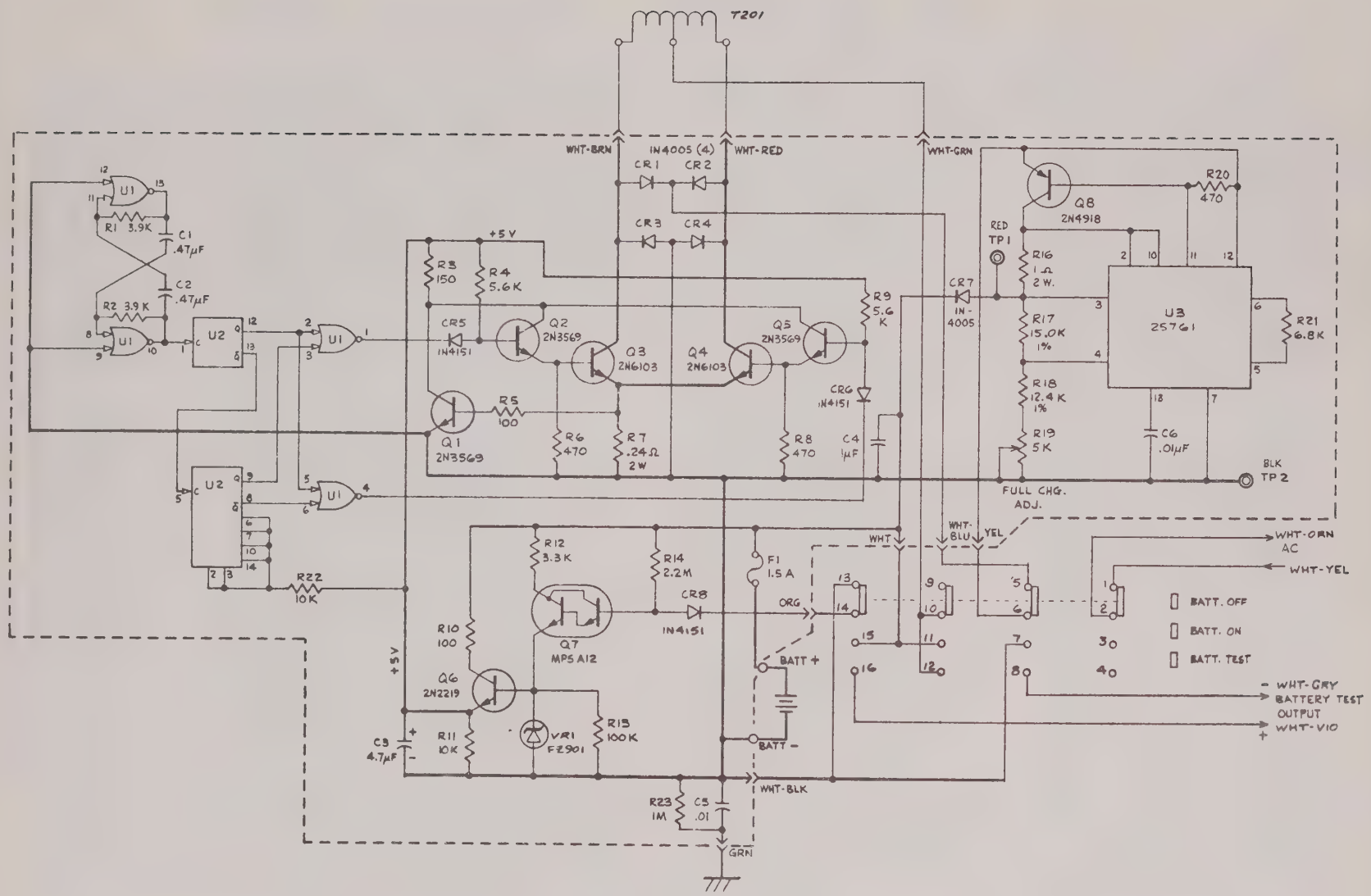
REPLACEABLE PARTS LIST

Equipment/Assembly Designation: OPT 09, BATTERY PACK #037219-4-1 (Cont'd)

(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
ITEM	REF					
32		ASSEMBLY, BATTERY CLAMP	06811	037227-4-1	1	037227-4-1
33		CLAMP, BATTERY INSULATED	06811	037472-1-1	1	037472-1-1
36		ASSEMBLY, BATTERY PACK	06811	037469-4-1	1	037469-4-1
41		TAPE, FOAM	06811	By description	22"	74041390



OPTION 09, A3, BATTERY PACK ASSEMBLY #037469-4-1 REV C



OPTION 09, A3, BATTERY PACK SCHEMATIC #037469-7-1 REV B

REPLACEABLE PARTS LIST

Equipment/Assembly Designation OPT 09, A3, BATTERY PACK #037469-4-1

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
	P.C. BOARD: Battery Pack	06811	037469-1-1	1	037469-1-1
A3C1	CAPACITOR, METAL MYLAR: .47 µF ±20%, 200 Vdcw	12406	ZD2A474	2	03284010
A3C2	CAPACITOR, METAL MYLAR: .47 µF ±20%, 200 Vdcw	12406	ZD2A474	2	03284010
A3C3	CAPACITOR, TANT: 4.7 µF ±10%, 25 Vdcw, radial lead	31433	K4R7W25K	1	03287820
A3C4	CAPACITOR, CERAMIC: 1 µF ±20%, 25 Vdcw	56289	5C023105X0250B3	1	C0879
A3C5	CAPACITOR, CERAMIC: .01 µF ±20%, 500 Vdcw	91418	TYPE SM	1	C0423
A3C6	CAPACITOR, CERAMIC: .01 µF +80-20%, 100 Vdcw	91418	TA110	1	C0556
A3CR1	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	5	CR0284
A3CR2	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	5	CR0284
A3CR3	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	5	CR0284
A3CR4	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	5	CR0284
A3CR5	SEMICONDUCTOR DEVICE, DIODE: Silicon, 50 Vdcw, 150 mA	03508	1N4151	3	CR0150
A3CR6	SEMICONDUCTOR DEVICE, DIODE: Silicon, 50 Vdcw, 150 mA	03508	1N4151	3	CR0150

REPLACEABLE PARTS LIST

Equipment/Assembly Designation: OPT 09, A3, BATTERY PACK #037469-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A3CR7	SEMICONDUCTOR DEVICE, DIODE: Silicon, 600 Vdcw, 1 A	04713	1N4005	5	CR0284
A3CR8	SEMICONDUCTOR DEVICE, DIODE: Silicon, 50 Vdcw, 150 mA	03508	1N4151	3	CR0150
A3F3	FUSE: 1.5 A, 250 Vdcw	71400	AGX 1 1/2	1	F0046
	HEATSINK: Reference A3Q8	98978	PA1-1CB	1	H1940
A3Q1	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3569	3	Q0318
A3Q2	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3569	3	Q0318
A3Q3	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	02735	2N6103	2	Q0317
A3Q4	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	02735	2N6103	2	Q0317
A3Q5	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N3569	3	Q0318
A3Q6	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	07263	2N2219	1	Q0246
A3Q7	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, NPN	04713	MPS-A12	1	Q0286
A3Q8	SEMICONDUCTOR DEVICE, TRANSISTOR: Silicon, PNP	04713	2N4918	1	Q0268
A3R1	RESISTOR, COMP: 3.9 kΩ ±5%, 1/4 W	01121	CB3925	2	R0939

REPLACEABLE PARTS LIST

Equipment/Assembly Designation OPT 09, A3, BATTERY PACK #037469-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A3R2	RESISTOR, COMP: 3.9 kΩ ±5%, 1/4 W	01121	CB3925	2	R0939
A3R3	RESISTOR, COMP: 150 Ω ±5%, 1/4 W	01121	CB1515	1	R0983
A3R4	RESISTOR, COMP: 5.6 kΩ ±5%, 1/4 W	01121	CB5625	2	R0821
A3R5	RESISTOR, COMP: 100 Ω ±5%, 1/4 W	01121	CB1015	2	R0966
A3R6	RESISTOR, COMP: 470 Ω ±5%, 1/4 W	01121	CB4715	3	R1044
A3R7	RESISTOR, WIRE WOUND POWER: .24 Ω ±5%, 2 W	75042	BWH	1	02394000
A3R8	RESISTOR, COMP: 470 Ω ±5%, 1/4 W	01121	CB4715	3	R1044
A3R9	RESISTOR, COMP: 5.6 kΩ ±5%, 1/4 W	01121	CB5625	2	R0821
A3R10	RESISTOR, COMP: 100 Ω ±5%, 1/4 W	01121	CB1015	2	R0966
A3R11	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	2	R0766
A3R12	RESISTOR, COMP: 3.3 kΩ ±5%, 1/4 W	01121	CB3325	1	R0742
A3R13	RESISTOR, COMP: 100 kΩ ±5%, 1/4 W	01121	CB1045	1	R0741
A3R14	RESISTOR, COMP: 2.2 MΩ ±5%, 1/4 W	01121	CB2255	1	R1014

REPLACEABLE PARTS LIST

Equipment/Assembly Designation OPT 09, A3, BATTERY PACK #037469-4-1 (Cont'd)

(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A3R15	Not used				
A3R16	RESISTOR, WIRE WOUND POWER: 1 Ω ±5%, 2 W	75042	BWH	1	R2855
A3R17	RESISTOR, METAL FILM: 15 kΩ ±1%, .12 W, 100 PPM	19701	MF5C-D-1502-F	1	R2073
A3R18	RESISTOR, METAL FILM: 12.4 kΩ ±1%, .25 W, 100 PPM	91637	MFF-1/4 T1	1	R2841
A3R19	RESISTOR, POTENTIOMETER, CERAMIC: 5 kΩ ±20%, 1/2 W, 4-turn, P.C. mt., top adjust	80294	3339H-1-502	1	R2697
A3R20	RESISTOR, COMP: 470 Ω ±5%, 1/4 W	01121	CB4715	3	R1044
A3R21	RESISTOR, COMP: 6.8 kΩ ±5%, 1/4 W	01121	CB6825	1	R0696
A3R22	RESISTOR, COMP: 10 kΩ ±5%, 1/4 W	01121	CB1035	2	R0766
A3R23	RESISTOR, COMP: 1 MΩ ±5%, 1/4 W	01121	CB1055	1	R0962
A3TP1	TEST POINT: Red, P.C. mt., right angle	74970	105-0852-001	1	E0279
A3TP2	TEST POINT: Black, P.C. mt., right angle	74970	105-0853-001	1	E0280
A3U1	INTEGRATED CIRCUIT: Quad, 2-input, NOR gate, TTL	01295	SN74L02N	1	025797
A3U2	INTEGRATED CIRCUIT: Dual, J-K flip-flop, TTL	01295	SN74L73N	1	045200

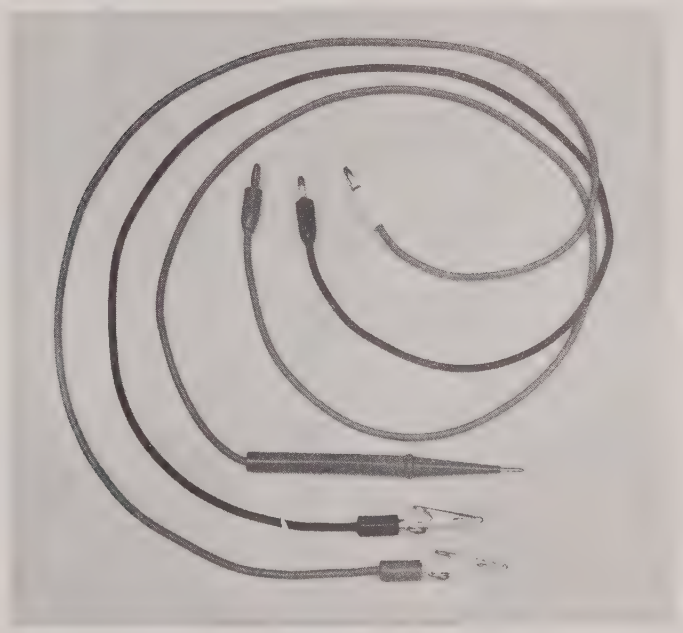
REPLACEABLE PARTS LIST

Equipment/Assembly Designation: OPT 09, A3, BATTERY PACK #037469-4-1 (Cont'd)

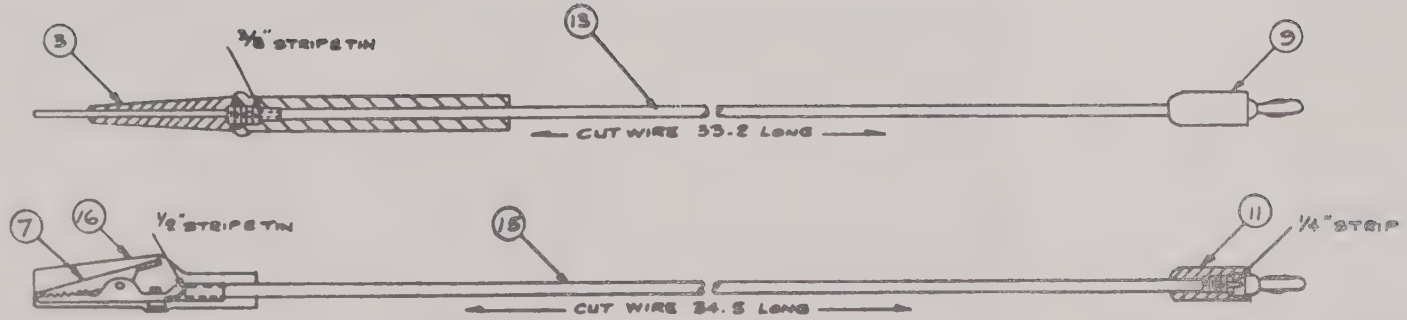
(1) Reference Designation	(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
A3U3	INTEGRATED CIRCUIT: Voltage Regulator, 2-37 V, .15 A, dipped	27014	LM723CN	1	025761
A3VR1	SEMICONDUCTOR DEVICE, ZENER: 5.6 Vdcw, 10%, 2 mA	13715	FZ901	1	26015340
	SPACER: Swage, 6 .06 mat.	71279	1247-11	2	E0275
	CONNECTOR, P.C.: Single pin, 10/inch, male post	00779	86090-4	9	E0322
	CLIP, FUSE: Single, P.C. mt.	91506	6008-32CT	2	36011880
	TERMINAL: Swage bifurcated	88245	1309B-1	2	E0191
	TERMINAL: Swage bifurcated	88245	2000B	9	E0100
	SCREW, PAN HEAD MACHINE: 4-40 X 3/8	MIL	MS51957-15	1	H0376
	SCREW, PAN HEAD MACHINE: 4-40 X 5/16	MIL	MS51957-14	2	H1273
	WASHER: Split-lock #4	MIL	MS35338-135	2	H0782
	NUT: Hex 4-40	MIL	NAS671C4	3	H0249
	COMPOUND, THERMAL	06811	H1055	A/R	H1055
	PAD, TRANSISTOR	08289	501-000-D	4	H0515
	TERMINAL, WIRE	79061	18204	2	H1967

CIRCUIT DESCRIPTION
ACCESSORY, INPUT TEST LEADS
ASSEMBLY #037232-4-1

The input test leads accessory includes two 35 inch test leads. The black lead is an alligator clip to banana plug combination, and the red lead is a test probe to banana jack combination.



INPUT TEST LEADS
(White banana plug to alligator clip optional.)



ALTERNATE POMONA MODEL 1059-36 BLACK
1086-36 RED

ACCESSORY, TEST PROBE KIT ASSEMBLY #037232-4-1 REV B

TABLE 6.4 REPLACEABLE PARTS LIST

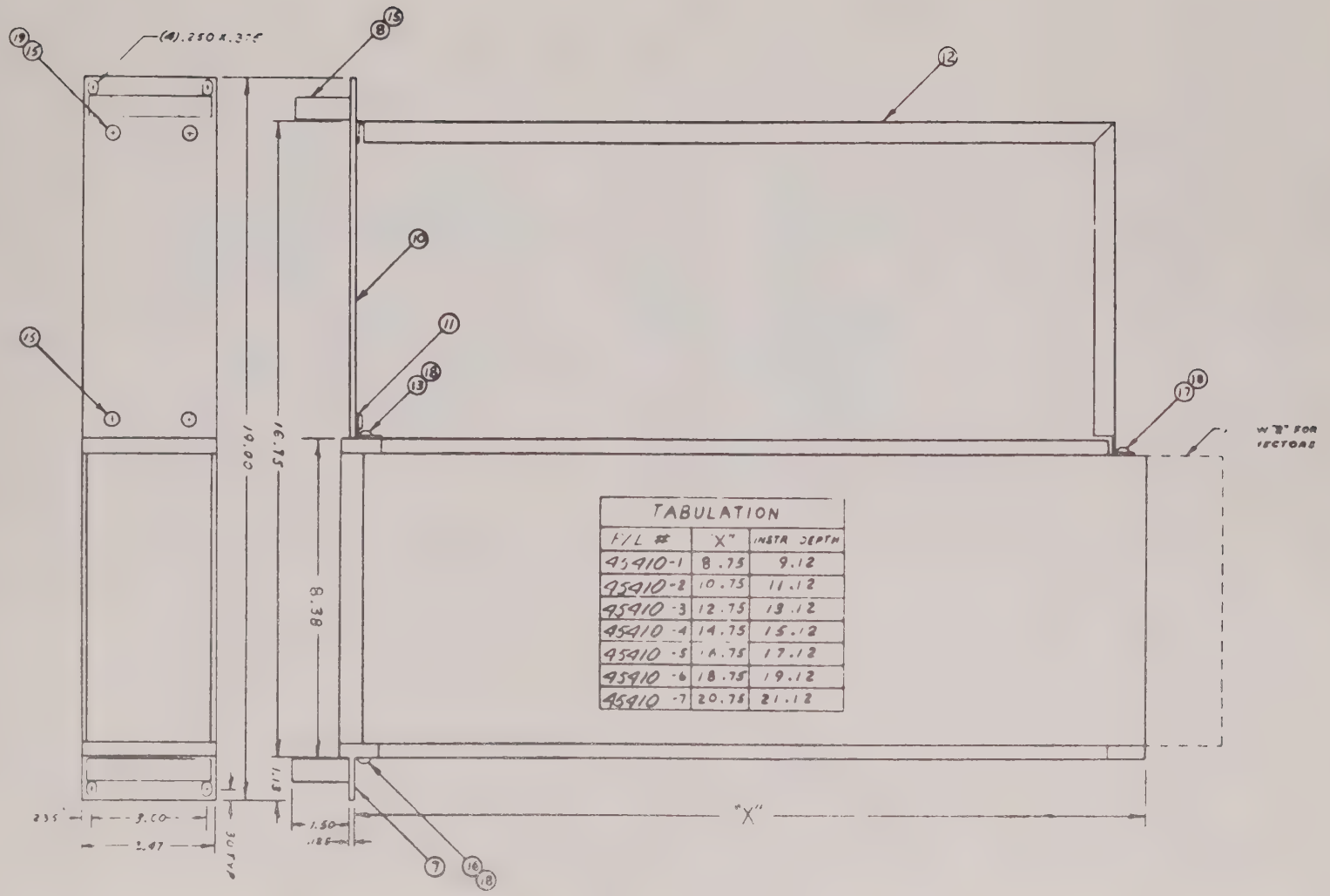
Equipment/Assembly Designation TEST PROBE KIT #037232-4-1

(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
ITEM	REF					
3		TEST-PROBE: Red, hi-volrage	91967	891R	1	E0313
7		CLIP, ALLIGATOR: Black	76545	60CS	1	E0311
9		PLUG, BANANA: Red	74970	108-0302-001	1	J0528
11		PLUG, BANANA: Black	74970	108-0303-001	1	J0529
16		CLIP, INSULATOR: Black	76545	62 BLACK	1	E0339
13		WIRE: Red	06811	W0090	A/R	W0090
15		WIRE: Black	06811	W0089	A/R	W0089

CIRCUIT DESCRIPTION
ACCESSORY, SINGLE RACK MOUNT KIT
ASSEMBLY #045410

The single rack mount kit allows one Model 7004A Digital Multimeter to be installed in a standard 19 inch rack. Two alternate end trims are removed along with the two handles, bail, and foot assembly. The rack mounting panel, adapter end trim, handles, and chassis adapter are then installed. The kit is symmetrical so the unit may be installed in either half of the rack.

SINGLE RACK MOUNT KIT



TABULATION		
F/L #	"X"	INSTR DEPTH
45410-1	8.75	9.12
45410-2	10.75	11.12
45410-3	12.75	13.12
45410-4	14.75	15.12
45410-5	16.75	17.12
45410-6	18.75	19.12
45410-7	20.75	21.12

ACCESSORY, SINGLE RACK MOUNT KIT ASSEMBLY #045410-3 REV A

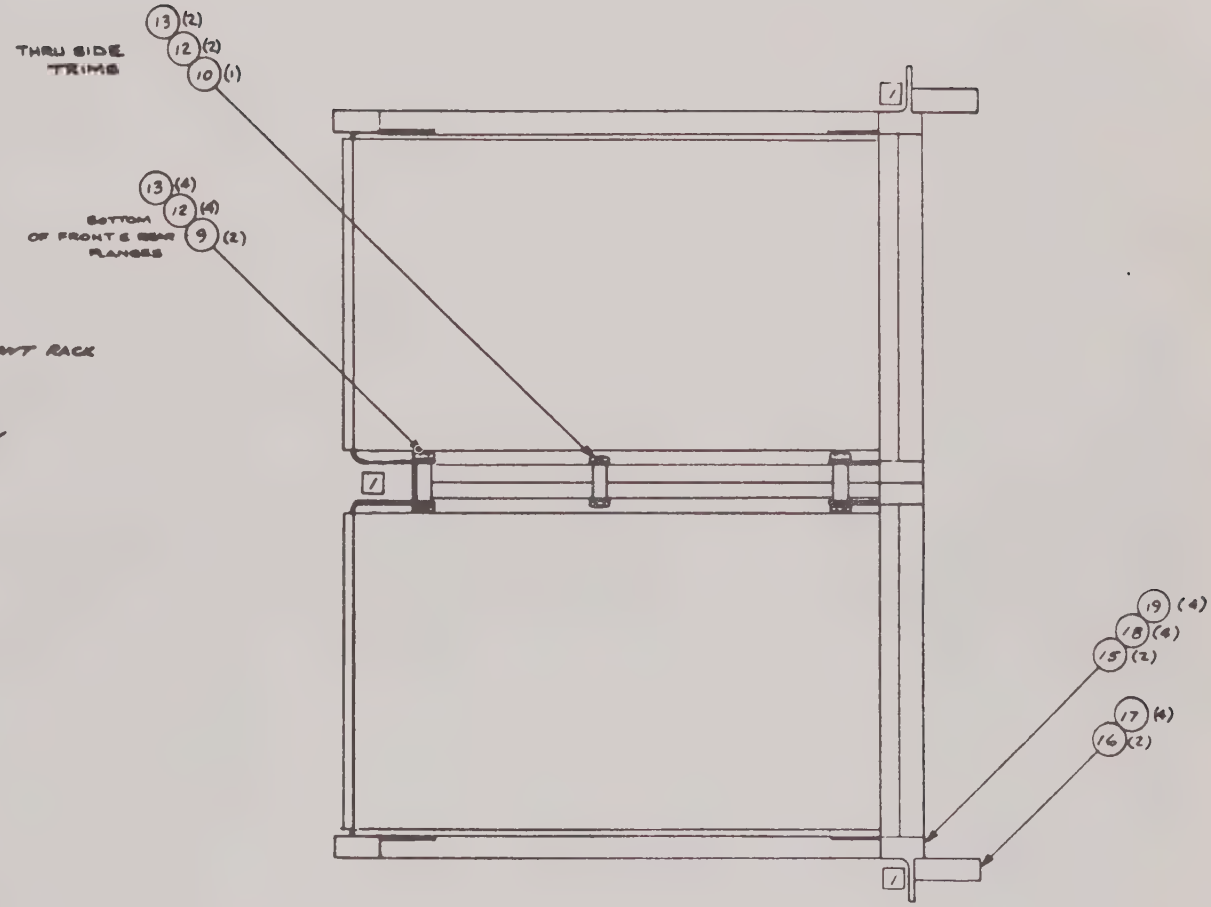
REPLACEABLE PARTS LIST

Equipment/Assembly Designation SINGLE RACK MOUNT KIT #045410-3

(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
ITEM	REF					
		DELETE THE FOLLOWING:				
		TRIM, END			2	033693
		HANDLE			2	033570-3
		ASSEMBLY, BAIL AND FOOT			1	H1927
		ADD THE FOLLOWING:				
7		TRIM, END	06811	045476-2	1	045476-2
8		HANDLE	06540	11351-A-0832-2	2	H1847
10		PANEL, RACK MOUNTING	06811	039953-2	1	039953-2
11		ADAPTER, RACK MOUNTING PANEL	06811	039954-2	1	039954-2
12		ADAPTER, CHASSIS	06811	045411-3	1	045411-3
13		SCREW, PAN HEAD MACHINE 8-32 X 5/8	MIL	MS51957-46	2	H1285
15		SCREW, FLAT HEAD MACHINE: 8-32 X 3/8	MIL	MS24693-C48	8	H1634
16		SCREW, PAN HEAD MACHINE: 8-32 X 5/8	MIL	MS51957-46	2	H1285
17		SCREW, PAN HEAD MACHINE: 8-32 X 5/16	MIL	MS51957-42	2	H1130
18		SHAKE: Int. tooth #8, crescent	MIL	MS35333-72	6	H0658
19		NUT: Kep 8-32	78189	511-081800-00	2	H1871

CIRCUIT DESCRIPTION
ACCESSORY, DUAL RACK MOUNT KIT
ASSEMBLY #037492-3

The dual rack mount kit allows two Model 7004A Digital Multimeters to be mounted side-by-side in the same 19 inch rack. Remove the opposite front end trims, both bottom covers, rear end trim, and handles; and add the rack mount, end trim with handles, and two spacers between the two units.



NOTE:

1. REMOVE 4 END TRIMS. REPLACE FRONT RACK END TRIMS AS SHOWN.
2. REMOVE 2 INNER SIDE HANDLES JOIN UNITS TOGETHER AS SHOWN
3. REPLACE BOTTOM COVER ASSEMBLY WITH ITEM 7 (NOT SHOWN).

ACCESSORY, DUAL RACK MOUNT ASSEMBLY #037492-3 REV A

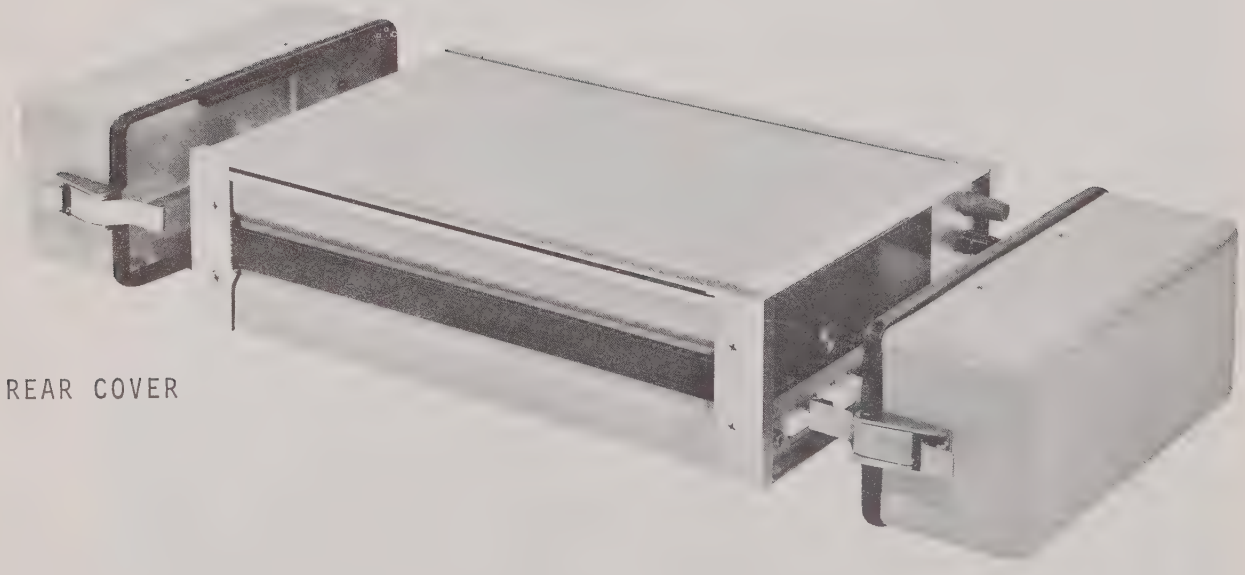
REPLACEABLE PARTS LIST

Equipment/Assembly Designation: DUAL RACK MOUNT #037492-3

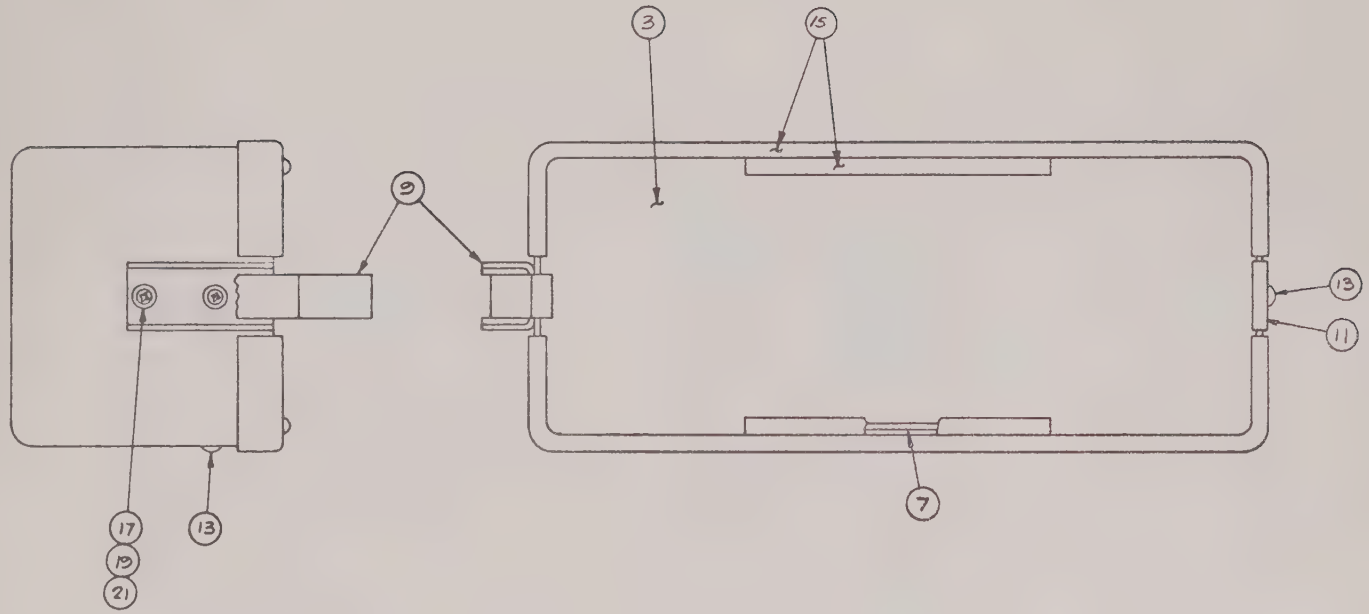
(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
ITEM	REF					
		DELETE THE FOLLOWING FROM 037190-4-1:				
		ASSEMBLY, BOTTOM COVER			1	045065-3
		TRIM, END			4	039033
		HANDLE			2	033570-3
		ADD THE FOLLOWING TO 037190-4-1:				
7		COVER, BOTTOM	06811	053050-3	1	053050-3
9		SPACER, THREADED: 6-32 X 5/8	88245	1550 F	2	E0109
10		SPACER, SWAGE: 6-32 X 3/4	06540	9541C-B-0632-3A	1	H1939
12		SCREW, PAN HEAD MACHINE: 6-32 X 1/4	MIL	MS51957-26	6	H0986
13		WASHER: Split-lock #6	MIL	MS35338-126	6	H0783
15		TRIM, END: Rack mounting	06811	045476-2	2	045476-2
16		HANDLE	06540	11351-A-0832-2	2	H1847
17		SCREW, FLAT HEAD MACHINE: 8-32 X 3/8	MIL	MS24693-C48	8	H1634
18		SCREW, PAN HEAD MACHINE: 8-32 X 5/8	MIL	MS51957-46	4	H1285
19		WASHER: Split-lock #8	MIL	MS35338-138	4	H0784

CIRCUIT DESCRIPTION
ACCESSORY, FRONT PANEL SNAP COVER
ASSEMBLY #037229-4-1

The protective front panel snap cover is completely assembled and hooks on to the front end trims.



FRONT AND REAR PANEL SNAP COVER



NOTES

1. SECURE ITEM 15 USING ITEM 23 (ADHESIVE)
   CLAMP ENDS OF ITEM 15 DURING CURING
   REMOVE EXCESS ADHESIVE WITH 3M N°2 SOLVENT.

   WARNING.

   ADHESIVE & SOLVENT MUST ONLY BE USED IN A
   WELL VENTILATED AREA.

ACCESSORY, FRONT PANEL SNAP COVER ASSEMBLY #037229-4-1 REV A

REPLACEABLE PARTS LIST

Equipment/Assembly Designation: FRONT PANEL SNAP COVER #037229-4-1

(1) Reference Designation		(2) Name of Component and Description	(3) Mfr's Code	(4) Manufacturer's Part Number	(5) No. Times Used	(6) Remarks/ SD Stock No.
ITEM	REF					
3		COVER, FRONT	06811	037229-1-1	1	037229-1-1
4		CAN, ALUMINUM	98376	M28895	1	H2021
7		COVER, STOP	06811	039411	2	039411
9		LATCH, MODIFIED	06811	039099	1	039099
11		HOOK, COVER	06811	045173	1	045173
13		RIVET: Semitubular	12014	R-3472X3/16 NICL	4	H2091
15		"U" CHANNEL, RUBBER	13862	S3430	A/R	H0207
17		SCREW, PAN HEAD MACHINE: 4-40 X 5/16	MIL	MS51957-14	4	H1273
19		WASHER: Flat #4	MIL	MS15795-803	4	H0758
21		WASHER: Split-lock #4	MIL	MS35338-135	4	H0782
23		ADHESIVE, RUBBER	06811	H1306	A/R	H1306
		LATCH	80477	AR-125-2	1	H1947

CHAPTER 7
SPECIAL MODIFICATIONS

7.1 INTRODUCTION

Modifications to the Model 7004A, requested by the customer, are documented in this chapter. These are usually extra-cost items to tailor the unit for a specific application.

CHAPTER 8
SUPPLEMENTAL INFORMATION

8.1 INTRODUCTION

This chapter contains revised or updated information reflecting changes in production requirements of this instrument. This information can include changes in assembly/schematic drawings, parts lists, operating instructions, calibration procedures, etc. Changes to parts lists will contain only the added parts, plus a list of deleted items. The supplemental pages for each assembly will be identified with the words SUPPLEMENTAL INFORMATION, followed by the nomenclature of the board. For example, if the A2, Switch Board is to be changed, the package identification will read as follows:

MODEL 7004A
SUPPLEMENTAL INFORMATION
A2, SWITCH BOARD
SCHEMATIC #037217-7-1

Page identification for an October 19XX change will be:

7004A-10-XX SUPPLEMENT; page numbering will be in numerical order following the basic package page numbering sequence, A2-1, A2-2 etc. A suffix letter is added to the page number to indicate the order of changes.